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MAGAZINE OF NATURAL HISTORY,

INCLUDING

ZOOLOGY, BOTANY, AND GEOLOGY.

(BEING A CONTINUATION OF THE 'ANNALS' COMBINED WITH LOUDON AND CHARLESWORTH'S 'MAGAZINE OF NATURAL HISTORY.')

CONDUCTED BY

ALBERT C. L. G. GÜNTHER, M.A., M.D., Ph.D., F.R.S.,
WILLIAM S. DALLAS, F.L.S.,
WILLIAM CARRUTHERS, F.R.S., P.L.S., F.G.S.,
AND
WILLIAM FRANCIS, Ph.D., F.L.S.

VOL. XX.—FIFTH SERIES.

LONDON:
PRINTED AND PUBLISHED BY TAYLOR AND FRANCIS.
SOLD BY LONGMANS, GREEN, AND CO.; SIMPKIN, MARSHALL, AND CO.;
KENT AND CO.; WHITTAKER AND CO.: BAILLIÈRE, PARIS:
MACLACHLAN AND STEWART, EDINBURGH:
HODGES, FOSTER, AND CO., DUBLIN: AND ASHER, BERLIN.
1887.

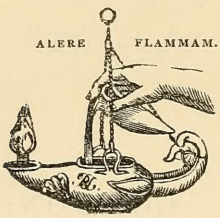
7357

"Omnes res creatæ sunt divinæ sapientiæ et potentiæ testes, divitiæ felicitatis humanæ:—ex harum usu *bonitas* Creatoris; ex pulchritudine *sapientia* Domini; ex œconomiâ in conservatione, proportione, renovatione, *potentia* majestatis elucet. Earum itaque indagatio ab hominibus sibi relictis semper æstimata; à verè eruditis et sapientibus semper exculta; malè doctis et barbaris semper inimica fuit."—Linnæus.

"Quel que soit le principe de la vie animale, il ne faut qu'ouvrir les yeux pour voir qu'elle est le chef-d'œuvre de la Toute-puissance, et le but auquel se rapportent toutes ses opérations."—Bruckner, *Théorie du Système Animal*, Leyden, 1767.

. . . . . The sylvan powers
Obey our summons; from their deepest dells
The Dryads come, and throw their garlands wild
And odorous branches at our feet; the Nymphs
That press with nimble step the mountain-thyme
And purple heath-flower come not empty-handed,
But scatter round ten thousand forms minute
Of velvet moss or lichen, torn from rock
Or rifted oak or cavern deep: the Naiads too
Quit their loved native stream, from whose smooth face
They crop the lily, and each sedge and rush
That drinks the rippling tide: the frozen poles,
Where peril waits the bold adventurer's tread,
The burning sands of Borneo and Cayenne,
All, all to us unlock their secret stores
And pay their cheerful tribute.

J. Taylor, *Norwich*, 1818.



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CONTENTS OF VOL. XX.

[FIFTH SERIES.]

NUMBER CXV.

Page

I. The Significance of the Yolk in the Eggs of Osseous Fishes. By Edward E. Prince, St. Andrews Marine Laboratory. (Plate II.) 1

II. Notes on Coleoptera, with Descriptions of new Genera and Species.—Part VI. By Francis P. Pascoe, F.L.S. &c. (Plate I.) 8

III. Catalogue of Ceylon Algæ in the Herbarium of the British Museum. By George Murray, F.L.S., Assistant, British Museum, and Examiner in Botany, Glasgow University 21

IV. Contribution to the Knowledge of the Land-Planariæ. By Dr. G. Bergendal 44

V. Descriptions of new Reptiles and Batrachians in the British Museum (Natural History).—Part III. By G. A. Boulenger 50

VI. A List of fifty *Erotylidæ* from Japan, including thirty-five new Species and four new Genera. By George Lewis, F.L.S. .. 53

New Book:—The Agricultural Pests of India, and of Eastern and Southern Asia, Vegetable and Animal, injurious to Man and his Products. By Surgeon-General Edward Balfour..... 74

On the Phylogeny of the Bopyrinæ, by MM. A. Giard and J. Bonnier; On Parasitic Castration in *Eupagurus Bernhardus*, Linné, and in *Gebia stellata*, Montagu, by M. A. Giard ..... 76—78

NUMBER CXVI.

Page

VII. Bryozoa from New South Wales, North Australia, &c. By Arthur Wm. Waters. (Plate IV.) 81

VIII. On new Reptiles and Batrachians from North Borneo. By G. A. Boulenger 95

IX. Notes from the St. Andrews Marine Laboratory (under the Fishery Board for Scotland).—No. VII. By Prof. M'Intosh, M.D., LL.D., F.R.S., &c. 97

X. Some new Hypotrichous Infusoria from American Fresh Waters. By Alfred C. Stokes, M.D. (Plate III.) 104

XI. Descriptions of new Species of Heterocerous Lepidoptera (Pyralites) from the Solomon Islands. By Arthur G. Butler, F.L.S., F.Z.S., &c. 114

XII. Description of a new Species of *Nucleolites*, with Remarks on the Subdivisions of the Genus. By Prof. F. Jeffrey Bell, M.A., Sec.R.M.S. 125

XIII. Description of two new Squirrels from North Borneo. By Oldfield Thomas 127

XIV. Descriptions of two new Species of Butterflies from South Afghanistan. By H. Grose Smith 129

XV. Descriptions of some new Species of Land-Shells from Sumatra, Java, and Borneo. By Edgar A. Smith 130

Proceedings of the Geological Society ..... 134—143

On the Races of the Honey-Bee, by the Rev. H. W. Lett, M.A., T.C.D; On the Organization of *Chætopterus*, by M. Joyeux-Laffuie; Further Note on the Generic Name *Muelleria*, by F. Jeffrey Bell; On a Copepod (*Cancerilla tubulata*, Dalyell) parasitic upon *Amphiura squamata*, Delle Chiaje, by M. A. Giard; On some Points in the Anatomy of the Rhynchobdellean Hirudinea, by M. Georges Dutilleul; Note on some Reptiles from Sumatra described by Bleeker in 1860, by G. A. Boulenger 143—152

NUMBER CXVII.

XVI. The Sponge-fauna of Madras. A Report on a Collection of Sponges obtained in the Neighbourhood of Madras by Edgar Thurston, Esq. By Arthur Dendy, B.Sc., F.L.S., Assistant in the Zoological Department of the British Museum. (Plates IX.–XII.) 153

XVII. On the *Pyrochroidæ* of Japan. By George Lewis, F.L.S. 165

Page

XVIII. On a new Species of *Semionotus* from the Lower Oolite of Brora, Sutherlandshire. By A. Smith Woodward, F.G.S., F.Z.S., of the British Museum (Natural History). (Plate VIII.) .. 175

XIX. Description of a new Genus of Chalcosiid Moths allied to *Pedoptila*. By Arthur G. Butler, F.L.S., F.Z.S., &c. 180

XX. Bryozoa from New South Wales, North Australia, &c. By Arthur Wm. Waters.—Part II. (Plates V. & VI.) 181

XXI. *Polyparium ambulans*, a new Cœlenterate. By Dr. A. Korotneff. (Plate XIII.) 203

XXII. Description of a new Genus and Species of *Polyzonidæ*. By R. Innes Pocock. (Plate XIV.) 222

XXIII. Descriptions of new Species of *Cicadidæ*. By W. L. Distant 226

XXIV. On the Blood-corpuscles of the Cyclostomata. By Prof. D'Arcy W. Thompson, Dundee 231

XXV. Note on a new Type of Compound Eye. By F. E. Beddard, M.A., F.Z.S. 233

XXVI. Note on the Hapuku of New Zealand (*Polyprion prognathus*). By Dr. A. Günther, F.R.S. 236

XXVII. On Australian Fishes of the Genus *Beryx*. By Dr. A. Günther, F.R.S. 237

XXVIII. Descriptions of new Species of Lepidoptera from the Solomon Islands, collected by C. M. Woodford, Esq. By A. G. Butler, F.L.S., F.Z.S., &c. 240

On the Structure of the Branchia of the Prosobranchiate Gasteropods, by M. Félix Bernard; Description of a newly-excluded Young of the *Ornithorhynchus paradoxus*, by Sir Richard Owen, K.C.B., F.R.S., &c.; *Aulax hypochœridis*, a new Gall-fly, by J. J. Kieffer; Anatomy and Histology of the Salivary Glands in the Cephalopoda, by M. L. Joubin; Habitat of *Peripatus Leuckarti*, by Prof. F. Jeffrey Bell ..... 247—252

NUMBER CXVIII.

XXIX. Bryozoa from New South Wales, North Australia, &c. By Arthur Wm. Waters.—Part III. (Plate VII.) 253

XXX. Descriptions of eight new Species of Asiatic Butterflies. By H. Grose Smith 265

XXXI. Description of a new Rat from North Borneo. By Oldfield Thomas 269

Page

XXXII. Notes on *Sphingidæ* from the Malay Peninsula, and Description of a new Species of *Ambulyx* from North Borneo. By W. L. Distant 270

XXXIII. On the Interpretation of *Polyparium ambulans*, Korotneff. By Prof. E. Ehlers 273

XXXIV. On a remarkable new Species of *Cladorhiza* obtained by H.M.S. 'Challenger.' By Arthur Dendy, B.Sc., F.L.S., Assistant in the Zoological Department of the British Museum. (Plate XV.) 279

XXXV. On the Classification of the Diplopoda. By R. Innes Pocock, Assistant Naturalist British Museum 283

XXXVI. Descriptions of new or little-known South-American Frogs of the Genera *Paludicola* and *Hyla*. By G. A. Boulenger.. 295

XXXVII. Notes from the St. Andrews Marine Laboratory (under the Fishery Board for Scotland).—No. VIII. By Prof. M'Intosh, M.D., LL.D., F.R.S., &c. 300

XXXVIII. A new Species of *Zygæna* from the Kurrachee Harbour. By James A. Murray, Vict. Nat. Hist. Inst. 304

XXXIX. Scent-organs in *Phryganidæ*. By Dr. Wilhelm Müller 305

XL. On the Sense-organs of the Turbellaria. By Dr. L. Böhmig 308

XLI. Notes on Batrachians from Perak. By Dr. A. Günther, F.R.S. (Plate XVI.)..... 312

Observation on Multiplication in *Amœbæ*, by Lillie E. Holman; On the Byssal Organ of the Lamellibranchiata, by M. Ludwig Reichel; Ovo-viviparous Generation in *Tropidonotus*; Literature of the Fossil Ganoid, *Semionotus*, by A. Smith Woodward ..... 316—320

NUMBER CXIX.

XLII. The True Nature of the "Madreporic System" of Echinodermata, with Remarks on Nephridia. By Prof. Marcus M. Hartog, D.Sc., M.A., F.R.U.I. 321

XLIII. The New System of *Chalininæ*, with some Brief Observations upon Zoological Nomenclature. By Arthur Dendy, B.Sc., F.L.S., Assistant in the Zoological Department of the British Museum 326

XLIV. A List of the Japanese *Silphidæ*, with Descriptions of new Species. By George Lewis, F.L.S. 338

XLV. On the so-called *Microdon nuchalis*, Dixon, from the Chalk of Sussex, a new Species of *Platax*. By A. Smith Woodward, F.G.S., F.Z.S., of the British Museum (Natural History)..... 342

Page

XLVI. List of Reptiles and Batrachians from Cyprus. By G. A. Boulenger 344

XLVII. On the Affinity of the North-American Lizard-Fauna. By G. A. Boulenger 345

XLVIII. Notes on *Volutharpa Perryi*. By Edgar A. Smith .. 347

XLIX. Descriptions of some new Genera and Species of Curculionidæ, mostly Asiatic.—Part IV. By Francis P. Pascoe, F.L.S. &c. 348

L. On the Phylogeny and Anatomy of the Echinodermata. By Dr. Otto Hamann 361

LI. On the Mammals collected by Captain C. E. Yate, C.S.I., of the Afghan Boundary Commission. By J. Scully 378

On the Affinities of the so-called Torpedo (*Cyclobatis*, Egerton) from the Cretaceous of Mount Lebanon, by A. Smith Woodward, F.G.S., F.Z.S; *Zygæna dissimilis*, Murray, by Francis Day, F.Z.S. &c.; On the Sexual Generation of *Chermes abietis*, Linn., by Dr. F. Blochmann ..... 389—390

NUMBER CXX.

LII. On "*Orthoceras* [*Endoceras*] *duplex*," Wahlenberg et auctt., with Descriptions of three new Species of *Endoceras* from the Ordovician of Sweden and Russia contained in the British Museum (Natural History). By Arthur H. Foord, F.G.S. 393

LIII. Description of a new Species of *Evechinus*. By F. Jeffrey Bell, M.A. (Plate XVII. figs. 7 & 8.) 403

LIV. On a rare Himalayan Toad, *Cophophryne sikkimensis*, Blyth. By G. A. Boulenger 405

LV. A List of the Reptiles and Batrachians obtained near Muscat, Arabia, and presented to the British Museum by Surgeon-Major A. S. G. Jayakar. By G. A. Boulenger 407

LVI. Notes on *Argonauta Böttgeri*. By Edgar A. Smith. (Plate XVII. figs. 1–6.) 409

LVII. Note on the Variations of *Amphiura Chiajii*, Forbes. By F. Jeffrey Bell, M.A. 411

LVIII. Description of a new Snake from Afghanistan. By G. A. Boulenger 413

LIX. Descriptions of two new Species of *Hyponomeutidæ* from the Solomon Islands. By A. G. Butler, F.L.S., F.Z.S., &c. 414

LX. Descriptions of two new Species of *Cicadidæ*. By W. L. Distant 415

LXI. Studies on the *Enchytræidæ*. By Dr. W. Michaelsen. (Plate XVIII.) 417

Page

LXII. Mr. Dendy on the *Chalininæ*. By R. von Lendenfeld 428

LXIII. Descriptions of six new Species of Butterflies captured by Mr. John Whitehead at Kina Balu Mountain, North Borneo. By H. Grose Smith 432

LXIV. On the Development of the Sexual Products in *Spongilla*. By Karl Fiedler..... 435

LXV. Diagnoses of two new Central-African Mammalia. By Oldfield Thomas..... 440

Proceedings of the Royal Institution of Great Britain 441

Proceedings of the Geological Society 443

Ægа crenulata (Lütken), by J. Duncan Matthews, F.R.S.E.; *Sebastes norvegicus*, by J. Duncan Matthews, F.R.S.E.; On a new Genus of Phosphorescent Lumbricidæ, and on the Type-species of that Genus, *Photodrilus phosphoreus*, Dugès, by M. A. Giard; Note on a new Species of *Cercopithecus* from Kaffa, in Central Africa, by Dr. Enrico H. Giglioli; On the Formation of the Calcareous Corpuscles in Holothuria, by M. Edgard Hérouard 444—450

Index 451

PLATES IN VOL. XX.

Plate I. New Genera and Species of Coleoptera.
II. Eggs of Osseous Fishes.
III. Freshwater Infusoria.
IV.–VII. Australian Bryozoa.
VIII. Semionotus Joassi.
IX.–XII. Madras Sponges.
XIII. Polyparium ambulans.
XIV. Pseudodesmus verrucosus.
XV. Cladorhiza pentacrinus.
XVI. Batrachians from Perak.
XVII. Argonauta Böttgeri.—Evechinus rarituberculatus.
XVIII. New Enchytræidæ.

TO THE READER.

In this year of Jubilees I have no small satisfaction in calling attention to the fact that the present Number closes the hundredth volume and the fiftieth year of the existence of the 'Annals and Magazine of Natural History.' Fifty years ago, fresh from the teachings of Ehrenberg and profoundly influenced by the spirit of scientific research which then, as now, prevailed in Germany, I suggested to Mr. Richard Taylor the establishment of a journal in which, while its pages were freely open to the original contributions of English naturalists, special attention should be paid to the researches of continental observers; and the result was the starting of the 'Annals of Natural History,' with which, subsequently, the well-known 'Magazine of Natural History' of Loudon and Charlesworth was amalgamated. The hope that such an undertaking, venturesome as it appeared, might prove a success was not disappointed—the 'Annals' immediately met with cordial support on the part of the most zealous students of nature in this country, and from its very commencement to the present day its pages have been enriched by valuable contributions from our most eminent naturalists. Consequently we can now look back upon a series of important original papers on various branches of Natural History which have made their appearance in the 'Annals,' while at the same time the communication of the results of the researches of continental naturalists has never been lost sight of; and the Editors feel that they have done good service in bringing under the notice of their fellow-workers in this country many

most important contributions published abroad. Under these circumstances I hope that I shall not be considered to be actuated by vanity in claiming that the Journal which I helped to set on foot fifty years ago, and the superintendence of which has been under my charge ever since, has in no small degree aided in the marked progress made by Natural-History studies in this country during the last half-century.

It may have been remarked, perhaps, that since the publication of the late Charles Darwin's 'Origin of Species' and other works, which have produced a greater effect upon human thought, not only in Natural History, but in the most varied departments, than any thing published since the days of Newton and Linnæus, the Editors of the 'Annals' have taken a position towards the new doctrine either opposed, or, at least, more or less "agnostic," to use the phrase by which Mr. Darwin himself characterized his position with regard to religious matters. This, however, has been without prejudice to a sincere admiration of the character and attainments of the man whose work in the most various departments of Natural History always showed a depth and solidity which, perhaps, in many minds were too much thrown into the shade by the brilliancy of his theoretical results. It must be recollected that some of the best systematic work done in this country during the last fifty years came from the same hand which has changed the whole face of Natural History, and that in his younger days his first introduction to Natural History consisted in collecting Insects and Plants, the incidents and pleasures connected with which seem to have been most vividly retained in his mind nearly to the end of his days. This lesson may be taken to heart by those who are too much inclined to start from the other end.

To return to the point from which we started. With the next number a Sixth Series will commence, and I trust that the 'Annals' may still receive the same kind support which

has always hitherto been accorded to it, and, further, that I may personally continue to enjoy the same friendship with the numerous contributors which it has been my good fortune to experience throughout the long course of the Journal's existence.

In conclusion, I must not fail to state how much I have been indebted to my Co-Editors, and especially to my dear friends the late Prof. Arthur Henfrey and Dr. J. E. Gray, and to my present colleagues, Dr. Günther and W. S. Dallas—to the latter especially, who had taken a most active part in superintending the publication for many years before his name appeared on the Titlepage.

WILLIAM FRANCIS.

Vol. 20. FIFTH SERIES. No. 115.

7357
Aug. 30/87

THE ANNALS AND MAGAZINE OF NATURAL HISTORY,

INCLUDING

ZOOLOGY, BOTANY, AND GEOLOGY.

CONDUCTED BY

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WITH TWO PLATES.

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THE ANNALS

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MAGAZINE OF NATURAL HISTORY.

[FIFTH SERIES.]

"..... per litora spargite muscum,
Naiades, et circùm vitreos considite fontes:
Pollice virgineo teneros hìc carpite flores:
Floribus et pictum, divæ, replete canistrum.
At vos, o Nymphæ Craterides, ite sub undas;
Ite, recurvato variata corallia trunco
Vellite muscosis e rupibus, et mihi conchas
Ferte, Deæ pelagi, et pingui conchylia succo."
N. Parthenii Giannettasii Ecl. I.

No. 115. JULY 1887.

I.—*The Significance of the Yolk in the Eggs of Osseous Fishes.* By EDWARD E. PRINCE, St. Andrews Marine Laboratory.

[Plate II.]

MUCH has been recently written upon the relation of the food-yolk and the germ in Teleostean eggs, yet little unanimity seems to characterize the conclusions reached by various observers. It is generally allowed that the free margin of the thickened blastodermic ring is really the lip of the blastopore—the entire periphery being so, and not merely, as Mr. Cunningham has ably shown *, an invaginated arc, as in the Elasmobranchs. The difference of opinion that exists arises, however, from the various views held as to the nature of the yolk and its function during development. Häckel, from his study of a pelagic ovum, concluded that the yolk in Teleostean eggs was emphatically distinct from the germ †, a contrast in the main constituents of the egg that M. Coste seems to have first truly signalized ‡. Later investigators (Klein,

* Quart. Journ. Microsc. Sci., Nov. 1885.
† Jenaische Zeitschr. vol. ix. 1875.
‡ Gazette médic. de Paris,' No. 17, 1855, p. 257.

Kingsley and Conn, and others) have adopted this view, according to which the egg of an osseous fish is, perhaps, one of the most marked examples of the meroblastic type.

In the Mammalian ovum we know that there is no such broad distinction; but, as in *Amphioxus*, the yolk that is present and the active protoplasm are so intermingled that segmentation is complete. The Amphibian ovum—*Rana*, for example, is also holoblastic; but the yolk so preponderates towards the vegetal pole that the cleavage-furrows, beginning at the opposite or animal pole, progress with increasing difficulty as they approach the former region. The animal pole in the Amphibian egg is distinguished by the great abundance of active protoplasm and the minute size of the suspended yolk-spherules, as well as its more rapid cleavage. Still more marked is this bipolar segregation in the Sauropsidan and Elasmobranch ovum; but in the Teleostean egg it is most complete—a distinctly marked germinal disk, composed almost entirely of clear protoplasm, being formed by the withdrawal of germinal matter from the granular yolk. The separation may be very apparent, even before fertilization, in certain Teleosteans—a *discus proligerus* collecting, similar to the superficial protoplasmic disk seen lying upon the yellow food-yolk in the mature Selachian ovum.

Usually both constituents are so intermingled as to be undistinguishable in the living egg until a period of one or two hours has elapsed after the entrance of the spermatozoon, when the translucent homogeneous blastodisk is rapidly outlined at the animal pole, either at the upper or the lower side of the egg, according to the species *. The separation of germinal matter from the food-yolk is carried to such a degree in the Teleostean ovum that it presents a marked contrast to the type of egg seen in the bird or shark, and still more in the frog or lamprey (compare figs. 1 and 2, Pl. II.). E. van Beneden, in his classical memoir "Sur la composition et la signification de l'œuf" †, speaks of the nutritive part as deutoplasm, and lays stress on its non-integral or accessory nature, on its purely passive function, and on the fact that in some eggs it is absent, though when it is present it serves to nourish the blastoderm and embryo. This contrast between the deutoplasm and the germinal protoplasm is illustrated in a marked degree in the Teleostean ovum, yet the existence in it

* In the Salmonidæ the germ surmounts the upper pole of the egg, whereas in the ova of the Pleuronectidæ and Gadidæ it is formed at the inferior pole.

† E. van Beneden, Mém. Cour. l'Acad. Roy. de Belgique, tome xxxiv. 1870.

of an extra-blastodermic layer of protoplasm (figs. 1, 9, and 10, *c.p.* and *perib.*, Pl. II.) must not be ignored. The very fact, however, that such an area or periblastic ring exists supports the view here propounded. If the protoplasm interfused amongst the yolk becomes, by a physical process of separation and superficial transference, concentrated at the animal pole, as represented in the diagram fig. 9, Pl. II., it is easy to see that some of it may be left at the margin as a peripheral ring. The process is slow, and much protoplasm may continue to pass towards the animal pole, even after the germinal disk is defined and segmentation is in progress. Such, in fact, is the case, and this is the explanation of the extra-germinal area, appropriately called periblast. Mr. G. Brook aptly expressed the condition of this area when he said * that the germinal protoplasm is for the most part included in the first two cells of the blastodisk, and, "as if not to waste any material, the remainder collects around this disk and is afterwards developed into the periblast." Further away from the disk the periblast (figs. 9 and 10, *perib.*, Pl. II.) thins out and gradually passes into a filmy protoplasmic layer, uniformly investing the remaining surface of the yolk and known as the cortical layer (Pl. II. figs. 9 and 10, *perib.*).

Kingsley and Conn affirm † that in the earliest stages the periblast is not present; and, paradoxical as it may seem, they are right, for the periblast, as such, does not exist until a later period—until, in fact, the limits of the disk are indicated with some precision by the progress of segmentation (compare figs. 1 and 9, Pl. II.). The protoplasmic cortex, of which the periblast forms merely a thickened annular portion, is really present from the moment that superficial segregation begins, and so long as the process continues the cortical layer persists, and even in advanced embryos it is distinguishable, passing beneath the embryonic trunk, between the hypoblast and the remnant of the yolk (Pl. II. fig. 11, *c.p.*). Segregation is not only superficial but, as stated elsewhere ‡, there is also a subgerminal transference, and Mr. Brook has shown § that in *Clupea* these deep-seated tracts form definite ramifications amongst the yolk. The periblast is simply germinal matter which has not yet entered the disk, and that it gradu-

* Quart. Journ. Microsc. Sci., Jan. 1885, p. 4.

† Mem. Boston Soc. Nat. Hist., April 1883, p. 202.

‡ "Develop. of the Food-Fishes," Ann. & Mag. Nat. Hist. 1886, vol. xvii. p 447.

§ 'Fourth Annual Report of Fishery Board for Scotland,' 1885, App. F, no. i. pp. 34, 35.

ates into the yolk below is not surprising, for its protoplasm is continually *in transitû*.

Now the yolk in the Amphibian ovum becomes divided by cleavage into large nucleated yolk-cells, just as in the egg of *Petromyzon* (Pl. II. fig. 2, *y*), and enters more or less intimately into the formation of the embryo. The ventral lining of the mesenteron is really yolk-hypoblast, and arises directly from the yolk-cells proper, as Mr. Shipley shows in *Petromyzon*: the dorsal wall "is composed of columnar cells resembling those of the general epiblast; the cells forming the floor have the same characters as the yolk-cells" * (Pl. II. fig. 7, *y*). Nothing like this is seen in the Teleostean egg, though Mr. Brook, relinquishing the view referred to on a prior page, has adopted the conception that Teleostean and Amphibian ova are similar even in the details of their development "the derivatives of the animal and vegetative poles are in both cases practically identical." If the mesenteron in Osseous Fishes does not arise as a slit in the thickened median hypoblast, as the greater part of it really seems to do, but is largely built up out of nucleated periblast, as Mr. Cunningham has suggested †, the yolk is still not directly concerned in the process, the periblast being, as Klein says, a continuation of the germ, both are "one and the same substance" ‡. Kupffer's vesicle, which arises as a sub-embryonic chamber, is not ventrally limited by the yolk, but by the periblast. Throughout the embryonic period in Teleosteans the periblast intervenes as a continuous layer between the yolk and the germ (as shown in Pl. II. figs. 7 and 11, *c.p.*). Oellacher speaks of the germ as feeding on the yolk §, and Kingsley and Conn say that particles of yolk seem to be taken in after segmentation has begun ‖, while Klein expresses the view, which Mr. Brook adopts, that the periblast performs the digestive function, so that, as the last-named author says, "large masses of yolk are incorporated within its substance and assimilated" ¶. The formation of the disk and early protoplasmic cortex is due, it is granted, to a kind of physical transference, mainly superficial segregation: At what point, it may be asked, does such segregation cease and digestion begin? No such point can be determined. The yolk, in fact, does not diminish to such an extent as the theory of digestion *plus* segregation would imply, as we see by comparing the

* Quart. Journ. Microsc. Sci., Jan. 1887, p. 329.
† *Ibid.*, Jan. 1885, p. 7, and Nov. 1885, pp. 20, 21.
‡ *Ibid.* vol. xvi. 1876, p. 118.
§ Zeitschr. f. Wiss. Zool. Bd. xxii. p. 4. ‖ *Loc. cit.* p. 127.
¶ 'Report of Fishery Board for Scotland,' 1885, p. 35.

bulk of the yolk in the early ovum (Pl. II. fig. 1, *y*) and in a later stage when the embryo is fairly advanced, as in Pl. II. fig. 3, *y*, and the very slight diminution that does occur (*vide* Pl. II. fig. 4, *y*) can be accounted for by the continued separation of the interfused protoplasm. The large size of the yolk-mass, in the emerged embryos of pelagic and demersal forms alike, indicates that any very active process of digestion is doubtful. That the globular ball of yolk is not an integral part of the germ or embryo is sufficiently shown by the ease with which it can be removed from its periblastic and embryonic envelopes in hardened specimens. The yolk seems to be chiefly utilized during the early stages of the active liberated embryo, diminishing greatly during the first fortnight after hatching (compare figs. 4 and 6, *y*, Pl. II.), and in those species which develop a vitelline circulation the rapid removal of the yolk-granules can be readily understood. In pelagic forms, without such vascular provision, the yolk is less rapidly used up; and, doubtless, in these the cœliac and hepatic blood-vessels, being in close proximity to the yolk-surface, effect the absorption.

All this evidences the accessory nature of the yolk in Teleosteans. It is an appendage—a cænogenetic addition or adaptation, as Häckel regarded it—not directly contributing to the building up of the tissues, but mainly serving to furnish pabulum to the delicate and rudimentary embryo on emerging from the egg It is not more essentially connected with the development of the germ than the egg-envelope *. In hardened preparations it shows a granular structure, and when physically manipulated often has the texture of dense cork; and in the young salmon, as Professor M'Intosh long ago described, the yolk becomes less fluid, and by-and-by springs from the touch of a glass rod like a rounded and smooth bit of cartilage on simply transferring the embryo from fresh to salt water †. In the living egg it is a clear albuminoid matrix of the consistency of syrup, readily issuing from a puncture in the yolk-sac (Pl. II. fig. 5, *y*), and containing minute vesicles and refrangible particles, with the addition, in certain species, of large oleaginous spheres. The presence of these spheres in the yolk adds strength to the view that it is a nutritive appendix, for, as shown in a pre-

* *Vide* Quart. Journ. Microsc. Sci. vol. xvi. 1876.—Note on p. 56, where Prof. Ray Lankester distinguishes the added food-material and egg-envelopes as "matrificial" and not "ovificial" elements, like the protoplasm of the egg-cell proper.

† Quart. Journ. Microsc. Sci. vol. viii. 1868, p. 153.

vious paper *, the globules in question seem to have no intimate connexion with development, and are best regarded as redundant and probably ancestral elements, still persisting, but not immediately utilized by the germ.

If this view be correct, that the yolk is a trophic appendage, consisting in the later stages almost purely of inert nutritive matter, that the germ is discoblastic and becomes a discogastrula when the germinal cavity appears beneath it (Pl. II. fig. 10, *g.c.*), and hence that the invaginated rim represents the primitive enteric involution, like the inflected arc in Elasmobranchs and Amphibians, then the interpretation of the features presented by the Teleostean ovum becomes greatly simplified. Balfour speaks of such a mass of unsegmented yolk as corresponding to the large cells of the vegetal pole in a blastosphere ; and E. van Beneden similarly regarded the deutoplasmic globe in a pelagic Teleostean ovum as a large endodermic cell, with a constitution analogous to a fat-cell †, a view shared by Hoffman and others. But the Teleostean germ never forms a blastosphere, with a more or less centrally situated segmentation-cavity or blastocœl, in addition to the large subgerminal chamber, which is always present at some stage. Van Bambeke alone amongst observers really describes a blastocœl in the egg of an osseous fish ; but Oellacher, Kingsley and Conn, and other authors regard such an intrablastodermic cavity as an artificial product, and not a normal feature. The sub-blastodermic cavity present in the Teleostean ovum (Pl. II. fig. 10, *g.c.*) must be the homologue not of the Amphibian and Selachian segmentation-cavity, so-called, but of the enteric cavity, whose external opening is the blastopore. The germ, thus separated by a germinal cavity from the yolk, consists of two lamellæ, ectoderm and primitive endoderm, like a two-layered gastrula ; the external layer or epiblast appears to be one cell in thickness ; but the endoderm, or "lower layer," consists of several layers of cells (Pl. II. fig. 10, *g*). From its mouth or blastopore the yolk forms an enormous protruding mass, an exaggeration of the yolk-plug which fills up the anus of Rusconi in *Rana* (Pl. II fig. 10, *y*).

The important feature in the Teleostean egg is not the fact that the yolk is stored away at one pole of the egg, for the egg of the Amphibian or Cyclostome may be described as simply the ovum of *Amphioxus* with a large amount of trophic matter stored away in its lower part, nor that the yolk-cells

* "On the Presence of Oleaginous Spheres in the Yolk of Teleostean Ova," Ann. & Mag. Nat. Hist., Aug. 1886.

† Quart. Journ. Microsc. Sci. vol. xviii. 1878, p. 52.

are broken down and form a syncytium, but that the germinal matter is so concentrated at one pole as to have little more connexion with the yolk than that of juxtaposition. The yolk seems to have no essential *rôle* in segmentation, but is an appendage to the early germ as to the later embryo. The nature and function of the periblast and cortical protoplasm need not be dwelt upon; they are continuous with and form part and parcel of the germ. The origin and fate of the nuclei which appear in them is by no means decided. As Klein declared, they are not identical with the yolk nuclei of the Elasmobranch egg *, and they probably originate, as Agassiz and Whitman hold, and as Wenckebach's recent researches tend to show †, in the segmented blastoderm itself. We know how greatly the food-yolk, when it crowds segmenting cells, alters their character and disposition; and the possibility seems naturally to follow that when, as in the Teleostean egg, the yolk becomes almost wholly separated from the germ, a less distorted and more primitive condition may be resumed. We can thus understand how, notwithstanding the great bulk of the yolk, the blastopore in Osseous Fishes is symmetrical, and coincides with the entire inflected margin of the germ, while the germ itself forms, not a blastosphere with a transient segmentation-cavity, as well as a permanent enteric invagination, but a concave two-layered gastrula, enclosing or rather arching over a primitive gastric chamber (Pl. II. fig. 10, *g.c.*). In this enteric chamber, roofed over by invaginated hypoblast and with a floor of periblast (Pl. II. fig. 10, *perib.*), the globe of passive yolk-matter (Pl. II. fig. 10, *y*) is seated, and projects from the blastopore until the free margin of the latter has so far progressed over its surface as to entirely envelop it. It persists in the perivisceral cavity as a ventral protuberance for some time after the embryo has emerged (Pl. II. fig. 6, *y*) until it is completely disintegrated and absorbed.

EXPLANATION OF PLATE II.

Fig. 1. Ovum of *Gadus æglefinus*, fifth hour; four blastomeres nearly completed. *bl.*, blastomeres; *c.p.*, cortical protoplasm passing to the animal pole; *y*, yolk.

Fig. 2. Ovum of *Petromyzon fluviatilis*, about same stage as fig. 1 (after Shipley), showing the yolk included in the segmentation process. *bl.*, blastomeres; *y*, yolk.

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* Quart. Journ. Microsc. Sci. vol. xvi. 1876, p. 128.

† Archiv f. mikr. Anat. Bd. xxviii. 1886.

Fig. 3. Ovum of *G. æglefinus*, some time after closure of the blastopore; the embryo fairly advanced, but the yolk (*y*) shows very slight diminution.

Fig. 4. Ovum of *G. æglefinus*; embryo about to emerge from the egg-capsule, which is ruptured. The yolk (*y*) has diminished to some extent, and a perivitelline chamber intervenes between the yolk-surface and the embryonic membrane (*e.m.*).

Fig. 5. Emerged embryo of a Pleuronectid, species not known. Portion of the yolk seen protruding from an accidental rupture in the embryonic membrane (*e.m.*).

Fig. 6. Embryo of *Gadus æglefinus*, six days after hatching; yolk (*y*) still persisting, but showing very evident diminution.

Fig. 7. Transverse section through embryo of *Petromyzon* (after Shipley). Yolk-cells (*y*) entering actively into the formation of the embryonic tissues, especially the gut (*g*): *n*, notochord; *mes.*, mesoblast.

Fig. 8. Transverse section of *Gadus æglefinus*, about same stage as fig. 7. The yolk (*y*) is separated from the embryo by the cortical protoplasm (*c.p.*) and the hypoblast (*hyp.*), and does not directly form embryonic tissue. *n*, notochord; *mes.*, mesoblast.

Fig. 9. Diagram of Teleostean ovum when the periblast (*perib.*) is first clearly distinguishable. The radial arrows indicate the passage towards the surface of the protoplasm mingled with the yolk (*y*), and forming the cortical protoplasm (*c.p.*). *g*, germ.

Fig. 10. Diagram of Teleostean ovum at a later stage. No intra-blastodermic segmentation-cavity exists; but a germinal cavity (*g.c.*) exists, roofed over by the germ and floored by periblast (*perib.*).

Fig. 11. Transverse section of *G. æglefinus* on second day after hatching. The cortical protoplasm (*c. p.*) still separates the embryo from the yolk (*y*). The hypoblastic gut (*g*) is now fully formed and invested by a layer of mesoblast; its lumen is ciliated. *e.m.*, embryonic membrane formed of two layers, epiblast and hypoblast.

II.—*Notes on Coleoptera, with Descriptions of new Genera and Species.*—Part VI. By Francis P. Pascoe, F.L.S., &c.

[Plate I.]

List of Genera and Species.

COLYDIIDÆ.

Bothrideres impressus.

PTINIDÆ.

Anobiinæ.

Clada (*n. g.*) Waterhousei.

TELEPHORIDÆ.

Drilinæ.

Eugeusis nigripennis.
Selasia pulchra.
—— laticeps.

TENEBRIONIDÆ.

OPATRINÆ.

Doryagus (*n. g.*) talpa.

TENTYRIINÆ.

Carchares (*n. g.*) macer.

COSSYPHINÆ.

Cossyphus limbatus.
—— pusillus.

EUTELINÆ.

Cyrtotyche quadra.

HELOPINÆ.

Immedia erosa.
Immedia integra.
Euphlœus (*n. g.*) verrucosus.

CNODALONINÆ.

Pimplema ampliata.
Chariotheca violacea.

LAGRIIDÆ.

Barsenis (*n. g.*) fulvipes.

RHIPIDIIDÆ.

Aporrhipis (*n. g.*) flexilis.

BRENTHIDÆ.

ITHYSTENINÆ *.

Diurus sphacelatus.
Cediocera (*n. g.*) longicornis.

Bothrideres impressus.

B. elongatus, niger, subopacus; prothorace disco reticulatim punctato, in medio postico oblongo-excavato, tuberculis duobus in cavitate inclusis; tibiis anticis subtriangularibus. Long. $4\frac{1}{2}$ lin.

Hab. Grahamstown.

Oblong, black, nearly opaque; prothorax not broader than long, gradually narrowing from near the apex to the base, the anterior angles rounded, disk reticulately punctured, with a deep oblong excavation beginning from towards the apex and continued to the base, and having two flat tubercles in the cavity; scutellum conspicuous; elytra broadest at the base, produced at the shoulders, each with five raised carinæ, the one bordering the suture flat, all minutely punctured, the interstices with a double row of large punctures; body beneath with scattered punctures; tibiæ stout, the outer edge toothed, the anterior subtriangular.

A well-marked species whose nearest affinity is perhaps with the Gabon *B. rubricollis*. In no other species, except *B. nocturnus*, are the anterior tibiæ so short and so broadly dilated.

CLADA.

Caput breve, deflexum; *palpi maxillares* articulo ultimo ovali.

* In 1862 I proposed to change Guérin's name of *Leptorhynchus* into *Ithystenus*, it having been used twice previously. Adopted by Lacordaire it became the type of his "groupe Ithysténides." Since Guérin's time the same name has been taken up by five different authors for as many genera. In the Munich Catalogue the authors, scorning to go outside the Coleoptera, adhere to Guérin's name.

Oculi prominentes, pilosi. *Antennæ* flabellatæ, articulo basali brevi, arcuato, apicem versus incrassato, secundo breviusculo, tertio ad decimum ramulos lineares emittentibus, ultimo elongato. *Prothorax* transversus, modice convexus, apice truncatus. *Elytra* latiuscula, ad latera parallela. *Pedes* mediocres; *tarsi* articulo basali incrassato; *unguiculi* graciles, divaricati. *Coxæ* anticæ et intermediæ contiguæ. *Corpus* pilosum.

The characters of this genus are much the same as those of *Ptilinus*, but the broad and less convex form and the hairy body are sufficiently distinctive. The tarsi stouter at the base and gradually narrower to the last joint, may be contrasted with the linear tarsi of *Ptilinus*. I have named the species after Mr. C. O. Waterhouse, to whom I am indebted for many valuable hints.

Clada Waterhousei. (Pl. I. fig. 4.)

C. latiuscula, subconvexa, rufo-ferruginea, supra pilis numerosis erectis vestita. Long. 3 lin.

Hab. Cape (Grahamstown).

Rather broad, moderately convex, reddish ferruginous, darker on the prothorax; eyes, body above, and legs clothed with erect long hairs; antennæ with the first two joints luteous, the remainder dark brown, the first only hairy; head and prothorax closely punctured; scutellum covered with decumbent hairs; elytra not broader than the prothorax, somewhat glossy, coarsely and closely punctured; body beneath slightly glossy, sparingly pubescent, dark brown, abdomen paler; basal joint of the tarsi not longer than two next together.

Eugeusis nigripennis. (Pl. I. fig. 7.)

E. breviuscula, pubescens, rufo-fulva; elytris subnitide nigris; antennis, articulo basali excepto, fuscis, pilosis. Long. 4 lin.

Hab. Burmah.

Rather short, pubescent, reddish fulvous, the elytra blackish, but a little lighter at the base; head large, broad; eyes small, black, distant from the prothorax; antennæ blackish, except the basal joint, and covered with short hairs, third joint longest, the rest gradually shorter and slighter; prothorax transverse, finely punctured, a broad concavity on each side at the base; scutellum triangular; elytra about two thirds longer than broad, closely and minutely punctured, each with three faintly raised lines; abdomen with seven segments.

This description is from a female; the male has probably flabellate antennæ, as in *E. palpator*. Prof. Westwood seems inclined to place the genus with the Telephorinæ; Lacordaire

refers it to the Drilinæ*. It is a most remarkable form, owing to its very large palpi, by which it is principally differentiated from *Selasia*. Judging from Westwood's figure, the eyes are close to the prothorax, in which respect it differs widely from the above.

Selasia pulchra. (Pl. I. fig. 8.)

S. breviuscula, modice convexa, fulva, pilis dispersis aureis vestita; elytris in medio fusco-nebulosis; capite parvulo. Long. 3½ lin.

Hab. Delagoa Bay.

Rather short and broad, the sides subparallel, fulvous, somewhat glossy, the elytra with a tinge of brown, except at the margins, and clothed with numerous (but not to the naked eye) conspicuous golden hairs, each arising from a minute puncture; head slightly exserted, much narrower than the prothorax; last joint of the maxillary palpi subsecuriform; eyes black; antennæ not extending to the base of the prothorax, the latter transverse, the base slightly emarginate in the middle; scutellum long, triangular; elytra substriate-punctate; body beneath and legs paler, hairy.

Only the males of this genus are known, but it only contained two West-African species, and one (doubtfully congeneric) from India. They are all exceedingly scarce in collections; of one species only a single example is known according to Lacordaire.

Selasia laticeps.

S. latiuscula, paulo convexa, pilosa, testacea; elytris pone basin gradatim infuscatis; capite prothorace latitudine æquali. Long. 2½ lin.

Hab. Bombay.

Moderately broad, slightly convex, clothed with long slender hairs, generally testaceous, but gradually deepening into brown behind the base of the elytra; head short, as broad as the prothorax; antennæ extending to the elytra, brownish, except the two basal joints, and furnished with stiff hairs; eyes large and close to the prothorax, the latter transverse, the base slightly rounded, the disk sparsely punctured; scutellum rather large, triangular; elytra broader than the prothorax at the base, the sides nearly parallel; irregularly and minutely punctured; legs slender; tarsi filiform.

I, at first, thought this species was generically differentiated from *Selasia* on account, *inter alia*, of its broad head, deeply immersed in the prothorax, and purposed calling it *Blastesis*;

* Prof. Westwood (Modern Class. of Insects) ranks them as families. Telephoridæ is now strictly equivalent to the older Malacodermata.

but for the present, as I have not cared to risk injury by examining the mouth, I leave it in *Selasia*.

Doryagus.

Caput exsertum, transversum ; *clypeus* haud discretus, apice emarginatus ; *mentum* breve, antice rotundatum ; *palpi maxillares* securiformes. *Oculi* transversi. *Antennæ* claviformes. *Prothorax* convexus, basi sinuatus. *Elytra* subconvexa, ovata, humeris dentato-productis. *Femora* valida ; *tibiæ* anticæ in medio late angulatæ, apice sulcatæ ; *tarsi* breves.

The sterna and abdomen are mainly as in *Anomalipus*, to which this genus is allied. Its chief differential characters are its prothorax very convex and not dilated at the sides, and its short tarsi in part received into a groove in the tibiæ. Perhaps the comparative shortness of the third antennal joint may be a good generic character.

Doryagus talpa. (Pl. I. fig. 9.)

D. oblongo-ovalis, niger, subnitidus ; antennis articulo tertio quam primus haud longiore. Long. 5 lin.

Hab. Natal.

Oblong-oval, black, somewhat glossy ; head closely granulate ; antennæ pitchy, rather short, the third joint not longer than the first, the rest transverse and gradually thicker to the tenth, the last smaller, rounded ; prothorax semicircularly emarginate anteriorly, the sides rounded and bounded by a fine raised line, disk finely and closely punctured, the spaces between the posterior punctures forming narrow irregular lines ; scutellum very transverse ; elytra moderately convex, rounded at the sides and apex, narrower at the base, the shoulders with a marked tooth-like process ; striate-punctate, punctures small, the fourth stria not attaining the base ; fore tibiæ strongly angulated in the middle, the apex, and also of the other tibiæ, grooved for the reception of the basal joints of the tarsi, these furnished with a few short spinous hairs beneath.

Carchares.

Caput exsertum, postice constrictum ; *clypeus* a capite haud discretus ; *labrum* transversum ; *labium* leviter emarginatum ; *palpi maxillares* articulo ultimo subtriangulari. *Oculi* reniformes. *Antennæ* normales, articulo secundo brevi, tertio elongato, quarto ad septimum æqualibus, cæteris leviter incrassatis, ultimo longiore. *Prothorax* transversus, convexus, lateraliter rotundatus, margine anguste carinato. *Elytra* ovalia, convexa ; *epipleuræ* angusta. *Prosternum* elevatum ; *mesosternum* subdepressum ; *processus intercoxalis* latus, antice subangulatus. *Abdomen* segmento quarto

brevi. *Pedes* graciles ; *femora* antica crassiora, dente acuto armata ; *tibiæ* posticæ elongatæ ; *tarsi* filiformes, postici articulis primo et ultimo æqualibus ; *unguiculis* longis, divaricatis.

With the facies of *Mesostena angusta* this genus, according to Lacordaire's arrangement, is more allied to the North-American *Triorophus*, but the mandibles are not uncovered by the labrum to the same extent as in *T. lævis*, for example. The most striking peculiarity is the well-developed tooth on the anterior thickened femora.

Carchares macer. (Pl. I. fig. 3.)

C. oblongo-ovatus, nitide niger ; labro, antennis tarsisque ferrugineis. Long. 5 lin.

Hab. Ngami.

Oblong-ovate, black, shining ; labrum, palpi, antennæ, and tarsi pale ferruginous ; head rather narrow, finely punctured, more closely on the constricted portion, between the antennary orbits a semicircular impression ; prothorax rather broader than long, with minute scattered punctures ; elytra with larger punctures and faintly striated ; body beneath smooth and finely punctured ; intermediate and posterior femora moderately clavate, their tibiæ moderately curved.

Cossyphus limbatus.

C. latiusculus, testaceo-piceus, late marginatus, marginibus leviter reticulatis ; elytris subseriatim punctatis ; scutello transversim triangulari. Long. 3 lin.

Hab. Cochin-China.

Rather broadly ovate, not narrowed behind, testaceous pitchy, the body not broader than the pale diaphanous margin ; prothorax finely punctured ; scutellum transversely triangular ; elytra irregularly punctured, the punctures larger than those on the prothorax ; legs slender.

Cossyphus * is one of the most isolated forms among the Coleoptera. A foliaceous margin surrounds the thorax and elytra as well as the head, which is imbedded under it. The species are all very similar in form and colour, but vary in size ; they have no wings or they are useless for flight, yet are found in Africa, north and south, India, Java, and South Australia. *C. Hoffmanseggii* is a common species under stones around Lisbon. The species here described is remarkable for its broad diaphanous margin, apparently indistinctly reticulated owing to its uniform coloration.

* *Cossyphus*, Fabr. 1792 ; *id.* Dum. 1802 (Birds) ; *id.* Val. 1839 (Fishes).

Cossyphus pusillus.

C. sublatiusculus, testaceo-piceus, modice marginatus, marginibus conspicue reticulatis; scutello valde transverso, postice rotundato; elytris sat rude seriatim punctatis. Long. 2 lin.

Hab. Rangoon.

Less broadly ovate, not narrowed behind, testaceous pitchy, the margins of the normal breadth and very obviously reticulate; prothorax finely punctured; scutellum very transverse, rounded behind; elytra rather coarsely punctured in somewhat irregular rows; legs slender.

About the size of *C. pygmæus*, but more broadly rounded in front, and the margins very distinctly reticulated. As in the preceding species, the elytra are without raised lines, except at the suture.

Cyrtotyche quadra.

C. fulvo-picea; prothorace vix transverso, tuberculis quatuor, duo apice minora, duo fere in medio majora, instructo; tibiis subrectis. Long. 4 lin.

Hab. Delagoa Bay.

Ovate, fulvous pitchy; front of the head and clypeus coarsely and densely punctured; antennæ blackish, last four joints forming the club; prothorax not broader than the elytra, convex above, narrowed at the base, four glossy tubercles on the disk, the two smaller near the apex, the two larger in the middle, one opaque tubercle on each side, and another (cariniform) below, the intervals coarsely and irregularly foveate; elytra broadest behind the middle, closely tuberculate, the larger tubercles in two rows on each elytron, close to and nearly confined to the sutural region a row of punctures with smaller tubercles accompanying them; body beneath and legs brownish, not glossy, abdomen punctured; femora and tibiæ roughly punctured, the latter nearly straight; anterior tarsal joints, except the last, very short.

Very distinct from *C. satanas*, the only other species, but unmistakably congeneric, although the character of curved tibiæ must now be dropped. *C. satanas* is a darker and much larger species, and has four oblong tubercles disposed transversely across the middle of the prothorax; the tubercles on the elytra are conical and more irregularly distributed, and the tibiæ are remarkably curved, but only towards the apex. Lacordaire has figured the species in his 'Atlas' (pl. lv. fig. 5), but has erroneously applied to it the name of a species of an allied genus—*Eutelus nodosus*.

Immedia erosa.

I. rotundata, valde convexa, cuprea; prothorace utrinque apicem versus incurvato; elytris seriatim ampliato-punctatis. Long. 4 lin.

Hab. Bahia.

Rounded, very convex, copper-brown, beneath darker; head with small, somewhat scattered, punctures; antennæ ferruginous, eighth and ninth joints rounded, the tenth nearly as long as broad; prothorax very short, the sides towards the apex incurved, disk irregularly punctured, each puncture with a bright green scale at the base; scutellum black, glossy, triangular; elytra with rows of largely impressed close-set punctures or foveæ, each having a greenish or bluish tint at the base; palpi and legs glossy ferruginous, the latter dotted with minute white scales.

A much larger species than *I. occulta* *, and at once differentiated by the incurvature of the sides of the prothorax; the clypeus also is better marked off from the head, and the terminal joints of the antennæ have a somewhat different form. The genus is more allied to *Sphærotus* than to *Cyrtosoma*, but the metasternum in both is much shorter than in the typical Cnodaloninæ and Helopinæ.

Immedia integra.

I. rotundata, valde convexa, cuprea; prothorace utrinque rotundato; elytris sparse seriatim punctatis, punctis majusculis, viridi-annulatis. Long. $3\frac{1}{2}$ lin.

Hab. Rio Janeiro.

Rounded, very convex, copper-brown; head finely punctured; antennæ ferruginous, eighth to tenth joints obconic; prothorax very short, the sides rounded, disk finely punctured; scutellum black, triangular; elytra with rows of rather large distant punctures, each surrounded with a greenish ring; legs copper-brown.

Very like the preceding, but with the sides of the prothorax entire and the terminal joints of the antennæ, except the last, obconic and longer than broad. If the three species are held to be congeneric, then the character derived from the antennæ will be seen to be only of specific value.

EUPHLŒUS.

Mentum quadratum; *palpi maxillares* securiformes; *mandibulæ* acutæ; *labrum* breve. *Antennæ* articulis 8, 9, 10 transversis.

* 'Annals,' Jan. 1882, p. 33. This species is represented in 'Aid,' vol. ii. pl. clviii. fig. 2.

Prothorax transversus, basi truncatus. *Scutellum* conspicuum. *Elytra* leviter convexa, humeris rotundatis; *tibiæ* muticæ; *tarsi* exigui, angusti.

In *Zophius* the ninth and tenth joints of the antennæ only are slightly transverse, and with the terminal joint scarcely forming a club; in *Euphlœus* there is a very marked club of four joints; this character and the small tarsi are the only technical ones differentiating the two genera. In *Osdara* the clypeus is distinctly limited, the mentum trapeziform, and the tarsi dilated. Lacordaire, in his key, separates these and allied genera by the "moderately broad" and "broad" intercoxal processes; but the difference is scarcely perceptible.

Euphlœus verrucosus.

E. ovatus, modice convexus, fusco-niger, supra rugosus; prothorace margine crenato; tibiis fere rectis. Long. 4 lin.

Hab. Malabar.

Ovate, moderately convex, brownish black; head slightly exserted, tuberculate, the clypeus marked off from the head by a shallow depression; antennæ pitchy, slightly pubescent; prothorax rounded and crenated at the sides, its posterior angles pointed, the disk closely covered with tubercles varying in size; scutellum smooth, glossy, transversely triangular; elytra shortly ovate, not broader than the prothorax, with rows of small mammiform tubercles along the striæ and much larger ones between them, the latter dotted with minute white scales; body beneath and femora rugose; tibiæ minutely tuberculate; tarsi ferruginous.

PIMPLEMA.

Caput parvum, ad oculos retractum; *clypeus* a capite haud discretus; *palpi maxillares* validi, cylindrici. *Antennæ* modice elongatæ, articulis sexto ad undecimum crassioribus, hoc multo longiore. *Prothorax* valde transversus, lateribus subplanatis. *Elytra* latissima, convexa; *epipleuræ* postice obsoletæ. *Femora* infra canaliculata; *tibiæ* rectæ; *tarsi* lineares. *Coxæ* anticæ globosæ. *Prosternum* clavatum; *mesosternum* latum, antice leviter emarginatum; *processus intercoxalis* antice rotundatus.

Mr. C. Waterhouse tells me that he thinks this genus is identical with *Hades*, Thoms., which that author placed in Nilionidæ, from which it differs in the globose and non-contiguity of the anterior coxæ. *Hades*, however, is not available, having been previously employed for a genus of Lepidoptera. The

species here described has the peculiarity of being rather broader than long, and is allied to *Artactes*, but it has not, as in that genus, the anterior tarsi dilated, a narrow mesosternum, nor the process between the posterior coxæ triangular. *Hemicyclus* has the anterior coxæ transverse, a character of only generic importance in this group.

Pimplema ampliata.

P. latissima, valde convexa, nigra, nitida, infra picea; pedibus testaceis. Long. 2 lin.

Hab. Penang.

Very broad and very convex, glossy black; head minutely punctured, scarcely produced beyond the edge of the prothorax; antennæ pitchy, slightly hairy, third joint longest; prothorax nearly twice as broad as long, impunctate, strongly incurved anteriorly; scutellum broadly triangular; elytra finely punctured in rows widely apart; body beneath pitchy, sparsely punctured; legs testaceous, hairy.

Chariotheca violacea.

C. sat breviter ovalis, violacea vel cyanea, nitida; antennis, scutello, corpore infra pedibusque nitide nigro-fuscis. Long. 3 lin.

Hab. Dorey.

Rather short, ovate, violet or bluish, shining; antennæ, scutellum, body beneath, and legs dark or blackish brown; antennæ with the seventh to the tenth joints transverse; head and prothorax with minute scattered punctures; scutellum transversely triangular; elytra seriate-punctate, punctures small, distant, the rows widely apart; prosternum coarsely, abdomen finely punctured; metasternum, except anteriorly, impunctate.

A smaller and shorter species than any of its congeners, and almost uniformly coloured above. *C. amaroides*, from Lizard Island, from its short metasternum can hardly be retained in this genus.

BARSENIS.

Caput parvum, collo angusto protensum. *Oculi* supra contigui, infra conjuncti. *Antennæ* flabellatæ, articulo ultimo longiore. *Palpi maxillares* securiformes. *Prothorax* cylindricus. *Elytra* ovata. *Pedes* mediocres; *tibiæ* lineares; *tarsi* articulo penultimo subbilobo, postici et intermedii articulo basali elongato; *unguiculi* simplices. *Prosternum* inter coxas elevatum. *Coxæ* anticæ et intermediæ subglobosæ.

The head, except the neck, clypeus, and the organs composing the mouth, is entirely enveloped by the eyes, which are largely faceted. The anterior cotyloid cavities being closed in behind places this genus with the Lagriidæ; the pectinate antennæ give it the facies of a Pyrochroid. *Emydodes* is another genus of this family, but with the antennæ only partially pectinate.

Barsenis fulvipes. (Pl. I. fig. 6.)

B. ovata, rufo-brunnea, fere glabra; antennis fuliginosis, pubescentibus; corpore infra pedibusque fulvis. Long. 3 lin.

Hab. Ega (Brazil).

Ovate, rufous brown, nearly smooth, except for a few long, slender, erect hairs; antennæ pubescent, as long as the elytra, the basal joint rather short, stout, second very short, third to the tenth emitting a moderately long and slender branch from the apex, the last joint as long as the two preceding together; prothorax longer than broad, with scattered punctures unequal in size; scutellum large, rounded behind; elytra much broader than the prothorax, striate-punctate, punctures approximate; body beneath and legs fulvous; tarsi hairy.

APORRHIPIS.

Caput transversum. *Oculi* prominuli, laterales, subrotundati. *Antennæ* flabellatæ, ante oculos insertæ. *Prothorax* transversus, utrinque reflexo-marginatus. *Elytra* elongata, dehiscentia. *Coxæ* anticæ separatæ; *tibiæ* muticæ; *tarsi* lineares; *unguiculi* minuti. *Abdomen* 5-segmentatum.

Allied to *Rhipidius*, in which the eyes are contiguous both above and beneath. The unique specimen here described, although perfect, is an extremely delicate form, and it is not easy to examine satisfactorily. The mouth, except the labial palpi, appears to be atrophied, as in *Rhipidius*, and, like which, the insect is probably parasitic. The antennæ, which are inserted in a cavity on each side of a knob-like protuberance in front, appear to be only six-jointed, but there may be ten, their long processes being so involved as to make certainty impossible.

Aporrhipis flexilis. (Pl. I. fig. 1.)

A. fusca, rufo-tincta, subtiliter pilosa; prothorace disco depresso, angulis posticis acutis. Long. 2 lin.

Hab. Pará.

Brown, with a rufous tint in part, clothed with minute hairs;

head depressed; eyes black, finely granulate; palpi filiform; antennæ five- or six-jointed?, the basal joint stout, the second very short, third with a short branch at the apex, a longer branch on the fourth, followed by five of still greater length, and all sprinkled with numerous hairs; prothorax transverse, narrow in front, rapidly broader to the base, its posterior angles acute, the disk slightly concave on each side; scutellum narrowly elongate; elytra rounded at the shoulder and apex, the disk flat, with three slender raised lines; legs pale, tibiæ dilated towards and obliquely truncate at the apex.

Diurus sphacelatus.

D. modice elongatus, parallelus, fuscus, squamis obscure griseis valde dispersis, sed ad apicem elytrorum magis approximatis; antennis novem-articulatis, articulis basalibus crassiusculis. Long. 13–14 lin. (♂), 5–10 (♀).

Hab. Andaman.

Moderately elongate, with the sides parallel, dark brown, with here and there a few oval dull greyish scales sunk in the punctures, more crowded at the apex, the tailed portion with long slender scales; head and rostrum, as far as the insertion of the antennæ, with tuberculiform close-set scales; antennæ nine-jointed, stoutish, especially the basal joints, clothed with long accumbent scales, the first four joints dark brown, the fifth and three following whitish, the latter very short, the fifth as long as the fourth and much curved, the last or ninth black, cylindrical; prothorax slightly grooved; elytra seriate-punctate, interstices raised; body beneath brown, greyish scales on the abdomen and a stripe of the same kind along the side; legs brown, dotted with elliptic and elongate grey scales.

M. Ritsema has described two species (Notes Leyden Mus. iv. p. 214) with nine-jointed antennæ, one, *D. antennatus*, from Java, also with the fifth joint curved, "strongly resembling *D. furcillatus*," differentiated, besides the antennæ, by the "elongate tails of the elytra." In *D. sphacelatus* the tails are scarcely half the length of the elytra, while they are as long or longer in *D. furcillatus*. When there is a departure from a normal character some amount of variability may be expected to occur even in the same species.

I may mention here that what I considered was the female of my *Diurus dispar*, Lacordaire was of opinion was an undeveloped male. Gemminger and von Harold, however, give it a place in their 'Catalogus' as a distinct species. I am now inclined to regard it as a dimorphic male of *D. furcillatus*, such as we find in many Anthribidæ; its normal male com-

panion in my collection has eleven-jointed antennæ, as also has one specimen in the British Museum.

Cediocera.

Diuro affinis, sed corpus esquamosum, prothorax sulcatus, antennæ 11-articulatæ, longiores, lineares, et coxæ anticæ separatæ. *Rostrum* apice angustum. *Elytra* canaliculata. *Femora* basi attenuata.

To these it may be added that the last three joints of the antennæ are much the longest; but I am not disposed to place much reliance on their relative length as a generic character. The females have the apical half of the rostrum much more slender than in *Diurus*.

Cediocera longicornis. (Pl. I. fig. 5.)

C. anguste elongata, fusco-ferruginea, regione suturali nigro-fusca; antennis in mare ad apicem abdominis extensis. Long. 13 lin.

Hab. Andaman.

Long and narrow, ferruginous brown, the sutural region dark brown; head with a shallow groove in the middle extending to the apex of the rostrum; antennæ extending to the apex of the abdomen, the basal joint pyriform, the second to the seventh of equal length, the last three much, and gradually, longer; prothorax reticulate-punctate at the sides, especially near the base; elytra striate-punctate, the interstices raised; the tail very slender and nearly as long as the rest of the elytra; body beneath pitchy, smooth; legs slender; first joint of the tarsi nearly as long as the rest together.

EXPLANATION OF PLATE I.

Fig. 1. *Aporrhipis flexilis*, and first four joints of antenna.
Fig. 2. *Taphroderes filiformis*, and fore tibia and tarsus ('Annals,' Nov. 1872, ser. 4, vol. x. p. 319).
Fig. 3. *Carchares macer.*
Fig. 4. *Clada Waterhousei*, and first three joints of antenna.
Fig. 5. *Cediocera longicornis* (the antennæ are too short).
Fig. 6. *Barsenis fulvipes*, and first three joints of antenna.
Fig. 7. *Eugeusis nigripennis*, and maxillary and labial palpi.
Fig. 8. *Selasia pulchra*, and three joints of antenna.
Fig. 9. *Doryagus talpa*, and fore tibia and tarsus.
Fig. 10. *Telethrus ebeninus*, distal part of fore tibia and the tarsus ('Annals,' Jan. 1882, ser. 5, vol. ix. p. 29).
Fig. 11. *Exapinœus politus*, and distal part of fore tibia and the tarsus (*loc. cit.* p. 34).

III.—*Catalogue of Ceylon Algæ in the Herbarium of the British Museum.* By George Murray, F.L.S., Assistant, British Museum, and Examiner in Botany, Glasgow University.

When the Trustees of the British Museum acquired the collection of Algæ formed by the late Prof. Dickie of Aberdeen, it was found that it contained a partly-named series collected by Mr. Ferguson in Ceylon. I have revised and completed the naming of this series so far as I judged it possible from the material. There are a fair number of specimens (as in all collections of Algæ) to which it is not possible to give more than a generic name. I have withheld these, and among them a species of *Callophyllis* and one of *Bryopsis*, which Prof. Dickie believed to be new. On most of these further material may, it is to be hoped, throw light. One species of *Spirogyra*, one *Zygnema*, one *Sirogonium*, one *Cladophora*, one *Prasiola*, and one *Lyngbya* have also received MS. names from Prof. Dickie. Mr. A. W. Bennett has kindly promised to deal with these in a paper on new freshwater Algæ in the British Museum Herbarium.

Prof. Harvey's list of Duplicate Ceylon Algæ extends to 105 numbers, not 106 as numbered. Nos. 48 and 87 are wanting, and no. 30 occurs twice. I have quoted all those named by him in full, or that I have found named since by Agardh, though a few of them are not in the British Museum. I have omitted the one Diatom *Biddulphia pulchella*, Grev., in the list. It was not distributed by Harvey, and we have no specimen of it from Ceylon. Harvey's list as quoted numbers 87. Ten are quoted as collected by Kjellman only. Mr. Ferguson, in addition to those collected by Harvey and by himself, has added 126 to the list, which in all numbers 223.

I make this Catalogue public now with the hope that by this means its extension may be more rapidly effected. Other collectors have been at work and, so far as the result of their labours supplements this list, it is to be hoped it will be made known.

An examination of the Algal Herbarium at Kew may be expected to yield additions, and the total would be considerably augmented by the citation of the Diatoms in the 'Catalogue des Diatomées de l'Ile Ceylan,' by Dr. G. Leuduger-Fortmorel. The British Museum Herbarium contains certain unpublished series of Algæ, which I have quoted in giving the distribution, *e. g.* "Bombay, Hobson!" and

"Kurrachee, Murray!" In those cases where no distribution is given the species is recorded for Ceylon only, so far as I can ascertain. Taking only the marine Algæ of the list it is found that there are 118 Florideæ, 33 Phæophyceæ, and 57 Chlorophyceæ. Of these 17 Florideæ, 2 Phæophyceæ, and 7 Chlorophyceæ are, so far as is known, peculiar to Ceylon. Of the rest, 60 Florideæ, 21 Phæophyceæ, and 27 Chlorophyceæ have been previously recorded for the Indian Ocean (including in it the Red Sea), many of these being species widely distributed throughout the shores of tropical, subtropical, and temperate seas. 8 Florideæ, 2 Phæophyceæ, and 1 green alga, hitherto known only from the Cape, are now recorded from Ceylon as well. Of Atlantic forms, 17 Florideæ, 5 Phæophyceæ, and 15 Chlorophyceæ, some of them known from Australia and from the Pacific as well, may be said to have now doubled the Cape. Of species hitherto recorded from Australia alone, 7 Florideæ and 1 green alga are added to the Ceylon list, while of Pacific species (including some common to Australia) 5 Florideæ, 3 Phæophyceæ, and 5 Chlorophyceæ are now known to extend to the Indian Ocean. Lastly, and this is an unsatisfactory record, 4 Florideæ and 1 green alga, hitherto recorded from the Mediterranean or Adriatic only, go to compose the following list.

Speculation on this record would be worthless in the present state of our knowledge; but I may venture to point out that ships' bottoms traversing the Suez Canal may be expected in time to affect the distribution of Mediterranean and Red Sea and Indian Ocean species.

I. Florideæ.

Ceramieæ.

Callithamnion pygmæum, Kütz.

Ferguson!

Geogr. distr. Mauritius, Adriatic.

Callithamnion purpuriferum, J. Ag.

Ferguson!

Geogr. distr. Cape of Good Hope.

Callithamnion thyrsigerum, Thw.

Harvey! No. 47. Ferguson!

Griffithsia corallina?, J. Ag., var.

Harvey! No. 46.

Geogr. distr. Atlantic Ocean (from Scotland to the Canaries), Mediterranean.

Griffithsia neapolitana, Näg.

Ferguson !
Geogr. distr. Naples.

Ceramium miniatum, Suhr.

Ferguson !
Geogr. distr. Pacific, Australia (St. Vincent, Cape Verds?).

Centroceras clavulatum, Ag.

Harvey ! No. 43.
Geogr. distr. Throughout all warm and temperate oceans.

Centroceras macracanthum, Kütz.

Ferguson !
Geogr. distr. Coast of Brazil.

Centroceras hyalacanthum, Kütz.

Ferguson !
Geogr. distr. Antilles, St. Vincent, Cape Verds.

Centroceras brachyacanthum, Kütz.

Ferguson !
Geogr. distr. Antilles.

Carpoblepharis ceylanica, Harv.

Harvey ! No. 42. Ferguson !

CRYPTONEMIACEÆ.

Halymenia platycarpa, Ag.

Harvey ! No. 52 (sub *Sarcodia*). Ferguson !
Geogr. distr. Pacific (Friendly Islands).

Halymenia floresia, Clem.

Ferguson !
Geogr. distr. Red Sea, Australia, Mediterranean, Atlantic.

Halymenia imbricata, Dickie, n. sp.

" Peltate, palmately lobed, lobes imbricate ; apices convex, laciniate."—*Dickie, MS.*

Ferguson !
Tutucorin, April 1875. " Found in dense, soft, flabby masses."—*Ferguson.*

Halymenia amœna, Bory.

Ferguson !
Geogr. distr. Cape Comorin.

Halymenia dubia, Bory.

Ferguson!

Geogr. distr. Cape Comorin.

Grateloupia filicina, Wulf.

Harvey! No. 40. Ferguson!

Geogr. distr. Indian Ocean, Cape of Good Hope, Pacific, throughout Atlantic, Mediterranean.

Cryptonemia rigida, Harv.

Harvey! No. 51.

GIGARTINEÆ.

Gigartina acicularis, J. Ag.

Ferguson!

Geogr. distr. Kurrachee (*Murray*!), Mediterranean, Atlantic, Cuba.

Gymnogongrus pygmæus, Grev.

Ferguson!

Geogr. distr. Indian Ocean.

Gymnogongrus glomeratus, J. Ag.

Ferguson!

Geogr. distr. Mauritius, Cape of Good Hope.

Gymnogongrus vermicularis, Turn.

Ferguson!

Geogr. distr. Mauritius, Cape of Good Hope, Chili and Peru, New Caledonia.

Gymnogongrus ligulatus, Harv.

Harvey! No. 50. Ferguson!

Geogr. distr. Japan? [J. G. Agardh, Spec. Gen. et Ord. Alg. vol. iii. p. 214, says, "*G. ligulatus*, Harv., Alg. Ceyl. mihi est Cryptonemiæ sp."]

Phyllophora Maillardi, Mont. et M.

Ferguson!

Geogr. distr. Indian Ocean. [J. G. Agardh, *loc. cit.* p. 682, states, "Fide iconis datæ hæc mihi nulla species *Phyllophoræ* videtur, sed *Cryptonemiæ* species e sectione Acrodisci, ad *Cr. rigidam* accedens, si cum hac non omnino identica sit." The specimen so named by Prof. Dickie has not the least resemblance to *Cryptonemia rigida*. It is distinctly a *Phyllophora*. I am inclined to regard it as *P. rubens*, var.]

Kallymenia perforata, J. Ag.

Hb. J. E. Gray! Ferguson!
Geogr. distr. [Agardh describes the species from a Ceylon specimen in Herb. J. E. Gray, now in Herb. Mus. Brit.]

SPYRIDIEÆ.

Spyridia insignis, J. Ag.

Harvey! No. 44. Ferguson.
Geogr. distr. Indian Ocean.

CHAMPIEÆ.

Champia parvula, Ag.

Ferguson!
Geogr. distr. Mediterranean, Atlantic, Pacific, Australia.

Champia affinis, Hook. et Harv.

Ferguson!
Geogr. distr. Australia, Tasmania, and New Zealand.

Champia ceylanica, Harv.

Harvey! No. 92.

Champia compressa, Harv.

Harvey! No. 16.
Geogr. distr. Cape of Good Hope, Australia?

RHODYMENIACEÆ.

Chrysymenia uvaria, Wulf.

Ferguson!
Geogr. distr. Tropical and subtropical Atlantic (Europe and America) and Australia.

Chrysymenia obovata, Sond.

Ferguson!
Geogr. distr. Australia.

Desmia tripinnata, J. Ag.

Ferguson!
Geogr. distr. Cape of Good Hope.

Desmia Hornemanni, J. Ag.

Ferguson!
Geogr. distr. Cape of Good Hope.

Desmia ambigua, J. Ag.

Harvey ! No. 21, and var. *pulvinata*, Harv. No. 91.

Geogr. distr. Indian Ocean, from Ceylon to Australia.

SQUAMARIEÆ.

Peyssonnelia rubra, Grev.

Harvey ! No. 41. (No specimen from Harvey in Herb. Mus. Brit.). Ferguson !

Geogr. distr. Adriatic. [Agardh criticises Harvey's naming of *P. rubra* from the Friendly Islands, and states that the Australian specimens are *P. Gunniana*. He further states that he has not seen Harvey's Ceylon specimen. While I therefore quote Harvey's No. 41 with hesitation, having seen no specimen, I give Ferguson's specimen as *P. rubra* on Prof. Dickie's authority. They are certainly quite distinct from Harvey's Friendly-Island specimens and the Australian specimens referred by Agardh to *P. Gunniana*. On the other hand, they are more like *P. Dubyi*, Crn., as named by Dickie himself, than the Mediterranean *P. rubra* that I have seen.]

PORPHYRACEÆ.

Porphyra laciniata, Ag.

Ferguson !

Geogr. distr. Throughout all warm and temperate oceans.

Porphyra vulgaris, Ag.

Harvey ! No. 82.

Geogr. distr. Throughout all warm and temperate oceans.

SPHÆROCOCCOIDEÆ.

Corallopsis cacalia, J. Ag.

Harvey ! No. 30.

Geogr. distr. Red Sea.

Gracilaria lichenoides, J. Ag.

Harvey ! No. 95. Ferguson !

Geogr. distr. Indian Ocean, Persian Gulf, Bombay (*Hobson* !).

Gracilaria confervoides, J. Ag.

Ferguson !

Geogr. distr. Indian, Southern, Pacific, and Atlantic Oceans.

Gracilaria crassa, Harv.

Harvey ! No. 29.

Gracilaria multipartita, Clem.

Ferguson!

Geogr. distr. Throughout Atlantic, Mediterranean, and Gulf of Mexico; New Zealand.

Gracilaria corticata, J. Ag.

Harvey! No. 96, sub *Rhodymenia purpurascens*, Harv. Harvey! No. 28. Ferguson!

Geogr. distr. Red Sea, Persian Gulf, and Indian Ocean; Kurrachee (*Murray*!).

Gracilaria obtusa, J. Ag.

Harvey! No. 30 *bis*. (No specimen from Harvey in Herb. Mus. Brit.)

Geogr. distr. Indian Ocean.

(*Cfr.* Agardh, Sp. Gen. et Ord. Alg. vol. ii. pars ii. p. 590, and vol. iii. p. 426.)

Sarcodia ceylanica, Harv.

Harvey! No. 27. Ferguson!

DELESSERIEÆ.

Nitophyllum marginale, Harv.

Harvey! No. 26.

Nitophyllum maculatum, Sond.

Ferguson!

Geogr. distr. Cape of Good Hope.

Caloglossa Leprieurii, J. Ag.

Ferguson!

Geogr. distr. Indian Ocean, Australia, and New Zealand, Atlantic.

HELMINTHOCLADIACEÆ.

Nemalion? attenuatum, J. Ag.

Ferguson!

Geogr. distr. Indian Ocean.

Scinaia furcellata, J. Ag.

Ferguson!

Geogr. distr. Indian Ocean (Kurrachee, *Murray*!, Bombay, *Hobson*!), Australia, Japan, Atlantic, and Mediterranean.

Scinaia carnosa, Harv.

Harvey! No. 38. Ferguson!

Liagora pulverulenta, Ag.

Ferguson!
Geogr. distr. Mauritius, Atlantic (trop. Amer.).

Liagora viscida, Forsk.

Ferguson!
Geogr. distr. Australia, Pacific, tropical and subtropical Atlantic, Mediterranean.

Galaxaura fragilis, Lam.

Ferguson!
Geogr. distr. Red Sea, Indian Ocean, Japan, Madeira.

Galaxaura rugosa, Sol.

Ferguson!
Geogr. distr. Tropical Atlantic, Mauritius, S. Andamans, China, Tahiti. [Agardh does not accept the Indian and Pacific specimens he has seen as *G. rugosa*. Having compared them with Atlantic specimens I cannot regard Agardh's reasons for separating them as sufficiently strong.]

Galaxaura lapidescens, Lam.

Ferguson!
Geogr. distr. Throughout tropical and subtropical oceans.

Galaxaura Pikeana, Dickie.

Ferguson!
Geogr. distr. Mauritius.

CHÆTANGIEÆ.

Zanardinia marginata, J. Ag.

Harvey! No. 36 (sub *Galaxaura*). Ferguson!
Geogr. distr. Throughout tropical and subtropical oceans.

GELIDIEÆ.

Pterocladia lucida, R. Br.

Ferguson!
Geogr. distr. Australia, New Zealand, Lord Howe's Island, St. Helena.

Gelidium variabile, Grev.

Harvey! No. 33. Ferguson!
Geogr. distr. Indian Ocean.

Gelidium corneum, J. Ag.

Harvey! No. 31, var. *proliferum*. Ferguson!
Geogr. distr. Indian, Pacific, and Atlantic Oceans.

Gelidium acrocarpum, Harv.

Harvey! No. 34. Ferguson!
Geogr. distr. Friendly Islands.

Gelidium intricatum, Ag.

Ferguson !

Geogr. distr. Indian Ocean, Pacific.

Gelidium rigidum, Vahl.

Harvey ! No. 32. Ferguson !

Geogr. distr. Tropical and subtropical Atlantic, Pacific, and Indian Oceans.

HYPNEACEÆ.

Hypnea hamulosa, J. Ag.

Ferguson !

Geogr. distr. Red Sea, Persian Gulf, Indian Ocean (Kurrachee, *Murray* !) ; Formosa, Cape of Good Hope. Doubtful specimen from Martinique.

Hypnea spinella, Ag.

Ferguson !

Geogr. distr. West Indies, Philippines.

Hypnea pannosa, J. Ag. ?

Harvey ! No. 94. Ferguson !

Geogr. distr. Gulf of Mexico. Agardh is doubtful of the Indian-Ocean specimens ; Ferguson's Ceylon, Harvey's Ceylon and Friendly-Island, and Pike's Mauritius specimens certainly hardly agree with a Barbadoes specimen named by Dickie, but I have not seen the type.

SOLIERIEÆ.

Meristotheca papulosa, Mont.

Harvey ! No. 39, sub *Halymenia ceylanica*, Harv. Ferguson !

Geogr. distr. Red Sea and Indian Ocean.

Rhabdonia tenera, J. Ag.

Ferguson !

Geogr. distr. Atlantic (West Indies and North America).

Rhabdonia robusta, Grev., var. *Wightii*, J. Ag.

Ferguson !

Geogr. distr. Indian Ocean. [The other variety, *β. flagelliformis*, is Australian.]

CHONDRIEÆ.

Laurencia heteroclada, Harv.

Ferguson !

Geogr. distr. Australia.

Laurencia perforata, Mont.

Harvey! No. 19. Ferguson!
Geogr. distr. In tropical and subtropical seas.

Laurencia obtusa, Huds.

Ferguson!
Geogr. distr. Throughout all warm and temperate oceans.

Laurencia hybrida, J. Ag.

Harvey! No. 18.
Geogr. distr. Mediterranean and Atlantic (Europe).

Laurencia ceylanica, J. Ag.

Harvey! No. 17.

Laurencia concinna, Mont.

Ferguson!
Geogr. distr. Australia, Philippines.

Laurencia fastigiata, Mont.

Ferguson!
Geogr. distr. Mediterranean.

RHODOMELEÆ.

Acanthophora Delilei, Lam.

Ferguson!
Geogr. distr. Red Sea, Mediterranean.

Acanthophora dendroides, Harv.

Harvey! No. 10.
Geogr. distr. Australia, Indian Ocean (Bombay, *Hobson*!)

Acanthophora Thierii, Lam.

Harvey! No. 9. Ferguson!
Geogr. distr. Throughout warm and temperate Atlantic, Pacific (Friendly Islands).

Martensia fragilis, Harv.

Harvey! No. 5.

Bryothamnion Seaforthii, Kütz.

Ferguson!
Geogr. distr. West Indies, Florida, Mexico, Brazil.

Bostrychia tenella, J. Ag.

Harvey! No. 11 (sub *B. calamistrata*, Mont.).
Geogr. distr. Throughout warmer Atlantic, Cape of Good Hope, Pacific (Friendly Islands).

Rhodomela (?) *crassicaulis*, Harv

Harvey! No. 8.

[Agardh places this species among "species exclusæ," without giving it another resting-place.]

Polysiphonia secunda, Ag.

Ferguson!

Geogr. distr. Mauritius, Atlantic, and Mediterranean.

Polysiphonia obscura, J. Ag.

Ferguson!

Geogr. distr. Throughout Atlantic, Mediterranean.

Polysiphonia Thwaitesii, Harv.

Harvey! No. 15. Ferguson!

Polysiphonia utricularis, Zanard.

Ferguson!

Geogr. distr. Red Sea, Indian Ocean (Kurrachee, *Murray*!).

Polysiphonia mollis, Hook. et Harv.

Ferguson!

Geogr. distr. Australia.

Polysiphonia corymbosa, J. Ag.

Harvey! No. 12. Ferguson!

Geogr. distr. Mauritius, Bombay (*Hobson*!).

Polysiphonia ferulacea, Suhr.

Ferguson!

Geogr. distr. Atlantic, Australia, Pacific.

Polysiphonia glomerulata, Ag.

Harvey! No. 13. Ferguson!

Geogr. distr. Indian Ocean, Pacific, Australia.

Spec. inquir.

Polysiphonia rigidula, Kütz.

Ferguson!

Geogr. distr. West Indies.

Neurymenia fraxinifolia, J. Ag.

Harvey! No. 49 (sub *Dictymenia*).

Geogr. distr. Indian Ocean, Madagascar, Western Australia.

Polyzonia jungermannioides, J. Ag.

Harvey! No. 6 (sub *Leveillia gracilis*, Dne.). Ferguson!
Geogr. distr. Red Sea, Indian Ocean, Australia.

Dasya struthiopenna, J. Ag.

Ferguson!
Geogr. distr. Australia.

Dasya stuposa, J. Ag.

Harvey! No. 7 (sub *D. crassipes*, Harv.). Ferguson!

Dasya Hussoniana, Mont.

Ferguson!
Geogr. distr. Red Sea.

Dasya villosa, Harv.

Ferguson!
Geogr. distr. Australia.

Dasya naccarioides, Harv.

Ferguson!
Geogr. distr. Australia.

Dasya Lallemandi, Mont.

Ferguson!
Geogr. distr. Red Sea, Persian Gulf, Kurrachee (*Murray*!), Australia.

Dictyurus purpurascens, Bory.

Harvey! No. 1. Ferguson!
Geogr. distr. Indian Ocean.

Vanvoorstia spectabilis, Harv.

Harvey! No. 3. Ferguson!
Geogr. distr. Mauritius.

Vanvoorstia coccinea, Harv.

Harvey! No. 4. Ferguson!

Claudea multifida, Harv.

Harvey! No. 2.

CORALLINEÆ.

Hapalidium roseum, Kütz.

Ferguson!
Geogr. distr. Adriatic.

Melobesia verrucata, Lam.

Ferguson!

Geogr. distr. Mauritius, throughout Atlantic, Mediterranean.

Amphiroa fragilissima, Lam.

Ferguson!

Geogr. distr. Bermuda, West Indies, St. Vincent (Cape Verds), St. Helena, Admiralty Island, Indian Ocean (South Andamans).

Amphiroa rigida, Lam.

Harvey! No. 22.

Geogr. distr. Mediterranean.

Amphiroa dilatata, Lam.

Harvey! No. 23. No specimen from Harvey in Hb. Mus. Brit. Ferguson!

Geogr. distr. Indian Ocean (Kurrachee, *Murray*!), Cape of Good Hope, Japan.

Amphiroa anceps, Lam.

Ferguson!

Geogr. distr. Mauritius, West Indies.

Amphiroa Bowerbankii, Harv.

Ferguson!

Geogr. distr. Cape of Good Hope.

Cheilosporum cultratum, Aresch.

Ferguson!

Geogr. distr. Mauritius, Cape of Good Hope, Brazil, West Indies.

Cheilosporum pulchellum, Harv.

Harvey! No. 24.

Arthrocardia capensis, Leach.

Ferguson!

Geogr. distr. Cape of Good Hope.

Jania micrarthrodia, Lam.

Ferguson!

Geogr. distr. Mauritius, Australia, New Zealand.

Jania natalensis, Harv., var. *tenuior*, Harv.

Harvey! No. 25. Ferguson!

Geogr. distr. Natal.

II. Phæophyceæ.

Fucaceæ.

Cystoseira triquetra, J. Ag.

Ferguson!
Geogr. distr. Cape of Good Hope, Red Sea.

Cystoseira articulata, Ag.

Ferguson!
Geogr. distr. Red Sea, (China Sea?).

Cystophyllum muricatum, J. Ag., var. *virgata*, J. Ag.

Ferguson!
Geogr. distr. Australia, New Caledonia, Sunda Islands, Persian Gulf.
[The above variety occurs both in the Persian Gulf and Australia.]

Sargassum piluliferum, Ag.

Ferguson!
Geogr. distr. Pacific (Japanese waters).

Sargassum polycystum, Ag.?

Ferguson!
Geogr. distr. Indian Ocean.

Sargassum ilicifolium, Ag.

Harvey! No. 103. Ferguson!
Geogr. distr. Indian Ocean, Red Sea, Pacific.

Sargassum Wightii, Grev.

Harvey! No. 106. Ferguson!
Geogr. distr. Indian Ocean, (Australia?).

Sargassum asperifolium, Her. et Mart.

Ferguson!
Geogr. distr. Red Sea, Socotra (*Balfour*!).

Turbinaria vulgaris, Ag.

Harvey! No. 102. Ferguson!
Geogr. distr. Indian Ocean, Australia, China seas.
J. G. Agardh (Spec. Gen. et Ord. Alg. vol. i. p. 267) notes "ad Zeylonam Mus. Paris."

DICTYOTACEÆ.

Dictyota fasciola, Lam.

Harvey! No. 57. Ferguson!
Geogr. distr. Mediterranean, West Indies.

Dictyota dichotoma, Lam.

Ferguson!
Geogr. distr. Throughout all warm and temperate oceans.

Dictyota crenulata, J. Ag.

Ferguson!
Geogr. distr. Pacific Ocean (coast of Mexico).

Dictyota Kunthii, Ag.

Ferguson!
Geogr. distr. South Pacific.

Dictyota acuminata, Kütz.

Ferguson!
Geogr. distr. Red Sea, Socotra (*Balfour*!), Bombay (*Hobson*!).

Taonia Schrœderi, J. Ag.

Ferguson!
Geogr. distr. Atlantic (Brazil) and Gulf of Mexico.

Padina pavonia, Gaill.

Harvey! No. 55. Ferguson!
Geogr. distr. Throughout all warm and temperate oceans.

Halyseris delicatula, Lam.

Harvey! No. 54. Ferguson!
Geogr. distr. Atlantic (Mexico, West Indies, Brazil).
J. G. Agardh (Spec. Gen. et Ord. Alg. vol. i. p. 116) notes that he possesses an aberrant form from Pernambuco, but doubts its claims to be regarded as a distinct species. The 'Challenger' specimens from Fernando Noronha also differ from the typical *H. delicatula*, and in some respects only, not in all, agree with Agardh's.

Halyseris polypodioides, Ag.

Ferguson!
Geogr. distr. Mediterranean, Atlantic, Southern Ocean (Tasmania).

Zonaria lobata, Ag.

Ferguson!

Geogr. distr. Atlantic, from Canaries, Bermuda, West Indies, and Brazil, to Cape of Good Hope.

Stœchospermum patens, Hering.

Ferguson!

Geogr. distr. Red Sea, Kurrachee (*Murray*!).

Stœchospermum marginatum, Ag.

Harvey! No. 53.

Geogr. distr. Red Sea.

Stœchospermum maculatum, J. Ag.

Ferguson!

Geogr. distr. Indian Ocean, viz. Mauritius, Bombay (*Hobson*!), Kurrachee (*Murray*!).

Stœchospermum Suhrii, Kütz.

Ferguson!

Geogr. distr. South Africa.

ECTOCARPACEÆ.

Ectocarpus arabicus, Kütz.

On *Chnoospora fastigiata*. Ferguson!

Geogr. distr. Red Sea (on *Sargassum*).

Ectocarpus indicus, Sond.

Ferguson!

Geogr. distr. Indian Ocean.

Ectocarpus macrocarpus, Harv.

Harvey! No. 101. Ferguson!

Sphacelaria furcigera, Kütz.

Ferguson!

Geogr. distr. Island of Karak, Persian Gulf.

MESOGLŒACEÆ.

Dermonema dichotomum, Grev. Alg. Wgt. ined. in Harv. List Dup. Ceyl. Alg.

Harvey! No. 93. Ferguson!

Geogr. distr. Indian Ocean, viz. Malabar (*Law*! Alg. Wgt.), Madras (*Hb. Hook.*), Mauritius; Pacific (*Spruce*!). This last locality presumably extends the distribution to South-American shores.

Cladosiphon erythræum, J. Ag.

Ferguson!
Geogr. distr. Red Sea.

ARTHROCLADIACEÆ.

Chnoospora fastigiata, J. Ag.

Harvey! No. 60. Ferguson!
Geogr. distr. Atlantic, Pacific, and Indian Oceans.

SPOROCHNACEÆ.

Asperococcus sinuosus, Roth.

Ferguson!
Geogr. distr. Red Sea, Kurrachee (*Murray*!), Mauritius, Australia, throughout Atlantic, Mediterranean, &c.

Asperococcus orientalis, J. Ag.

Ferguson!
Geogr. distr. Indian Ocean.

RALFSIACEÆ.

Ralfsia ceylanica, Harv.

Harvey! No. 59. This Alga was not distributed with Harvey's numbered set; but the British Museum possesses a specimen which had been sent to Prof. Dickie from the Trinity College herbarium. Ferguson!

III. CHLOROPHYCEÆ.

SIPHONACEÆ.

Caulerpa asplenioides, Grev.

Harvey! No. 65. [Published in Harvey's list; no specimen in Herb. Mus. Brit.]
Geogr. distr. St. Thomas, Jamaica (*Chitty*!), Australia.

Caulerpa clavifera, Ag.

Harvey! No. 62. Ferguson!
Geogr. distr. Throughout tropical and subtropical seas.

Caulerpa fissidentoides, Grev.

Ferguson!
Geogr. distr. Indian Ocean.

Caulerpa imbricata.

Kjellman! Sub *Chauvinia*, Wittr. et Nordst. Alg. Exsicc. No. 346.

The above form is not to be confused with *Chauvinia imbricata*, Harv. Phycol. Austr., an Alga allied to *Delesseria*. *Chauvinia* of Harvey was established since "the genus *Chauvinia*, Bory, founded on a part of the older genus *Caulerpa*, has not been generally adopted by botanists." Kützing, who maintained the *Chauvinia* of Bory, quotes *Chauvinia imbricata*, Harv., as *Delesseria rigida*, Harv. (Harv. Alg. Exsicc. Austr. No. 276). Dr. Kjellman, following Kützing in maintaining Bory's *Chauvinia*, has since published, as above, *C. imbricata*, Kjellm.

Caulerpa laxa, Grev.

Harvey ! No. 64.
Geogr. distr. Indian Ocean.

Caulerpa macrophysa, Sond.

Ferguson !
Geogr. distr. Atlantic, coast of Central America.

Caulerpa mexicana, Sond.

Ferguson !
Geogr. distr. Mexico, West Indies, Bermuda, Florida, St. Vincent, Cape Verds.

Caulerpa plumaris, Ag.

Harvey ! No. 61. Ferguson ! Kjellman ! Wittr. et Nordst. Alg. Exsicc. No. 344.
Geogr. distr. Indian Ocean, Red Sea, Pacific, Australia, Venezuela, West Indies, Florida.

Caulerpa scalpelliformis, Ag.

Ferguson !
Geogr. distr. Kurrachee (*Murray* !), Bombay (*Hobson* !), Mauritius, Australia, Brazil, Angola.

Caulerpa sedoides, Ag.

Ferguson !
Geogr. distr. Kurrachee (*Murray* !), Australia, Pacific, West Indies.

Caulerpa taxifolia, Ag.

Ferguson !
Geogr. distr. Throughout tropical seas.

Stephanocœlium verticillatum, Kütz.

Ferguson ! Kjellman ! Wittr. et Nordst. Alg. Exsicc. No. 347.
Geogr. distr. Torres Straits, Central America.

Halimeda gracilis, Harv.

Harvey ! No. 72.

Halimeda macroloba, Dne.

Ferguson !

Geogr. distr. Red Sea, Indian Ocean, Pacific, Australia.

Halimeda opuntia, Lam.

Harvey ! No. 71. Ferguson !

Geogr. distr. Throughout tropical seas.

Halimeda triloba, Dne.

Ferguson !

Geogr. distr. Red Sea, Indian Ocean, South Pacific, West Indies.

Halimeda tuna, Lam.

Ferguson ! Harvey ! No. 70. [Harvey did not distribute this species, and there is no Ceylon specimen of his collecting in Herb. Mus. Brit.]

Geogr. distr. Mediterranean, Florida, West Indies, Brazil, St. Vincent, Cape Verds.

Udotea flabellata, Lam.

Ferguson !

Geogr. distr. Torres Straits, Friendly Islands, Bermuda, West Indies.

Codium adhærens, Ag.

Harvey ! No. 69.

Geogr. distr. Red Sea, Mauritius, Friendly Islands, Mediterranean, British Channel, Bermuda, West Indies.

Codium tomentosum, J. Ag.

Harvey ! No. 68. Ferguson !

Geogr. distr. Throughout all warm and temperate seas.

Bryopsis hypnoides, Lam.

Ferguson !

Geogr. distr. British Channel.

Bryopsis pachynema, G. v. Mart.

Kjellman ! Wittr. et Nordst. Alg. Exsicc. No. 349.

Geogr. distr. Sumatra.

Bryopsis plumosa, Ag.

Harvey ! No. 66, and *B. plumosa*, Ag. var., No. 67. Ferguson !

Geogr. distr. Throughout all warm and temperate seas.

Bryopsis thuyoides, Kütz.

Kjellman! Wittr. et Nordst. Alg. Exsicc. No. 348.
Geogr. distr. Mediterranean, Guadaloupe.

VALONIACEÆ.

Valonia confervoides, Harv.

Harvey! No. 73. Ferguson!
Geogr. distr. Friendly Islands.

Valonia fastigiata, Harv.

Harvey! No. 74.
Geogr. distr. Mauritius, Pacific.

Valonia Forbesii, Harv.

Harvey! No. 75.
Geogr. distr. Friendly Islands.

Valonia utricularis, Ag.

Ferguson!
Geogr. distr. Mediterranean, Atlantic (coast of Spain and Madeira), Friendly Islands.

Ascothamnion intricatum, Kütz.

Hb. S. O. Gray! No collector's name.
Geogr. distr. Friendly Islands, Mediterranean, Guadeloupe (West Indies).

Microdictyon Agardhianum, Dne.

Ferguson!
Geogr. distr. Indian Ocean, Pacific.

Anadyomene flabellata, Lam.

Ferguson!
Geogr. distr. Mediterranean, Bermuda, West Indies.

Dictyosphæria favulosa, Dne.

Harvey! No. 77. Ferguson!
Geogr. distr. Red Sea, Indian Ocean, Pacific West Indies.

ULVACEÆ.

Enteromorpha compressa, L.

Ferguson!
Geogr. distr. Throughout all oceans.

Enteromorpha complanata, Kütz.

Ferguson!
Geogr. distr. European coasts, Indian, Pacific, and Antarctic oceans.

Enteromorpha africana, Kütz.

Ferguson!
Geogr. distr. Cape of Good Hope.

Ulva fasciata, Delile.

Harvey! No. 100. Ferguson! Kjellman! Wittr. et Nordst. Alg. Esicc. No. 432.
Geogr. distr. Indian Ocean (Kurrachee, *Murray*!, Bombay, *Hobson*!), Mediterranean, tropical Atlantic, and Pacific (Chili).

Ulva fenestrata, Post. et Rupr.

Ferguson!
Geogr. distr. Kamtschatka.

Ulva latissima, L.

Ferguson!
Geogr. distr. Throughout all oceans.

Ulva reticulata, Forsk.

Harvey! No. 83.
Geogr. distr. Indian Ocean (Kurrachee, *Murray*!), Philippines.

BATRACHOSPERMEÆ.

Batrachospermum moniliforme, Roth.

Ferguson!
Geogr. distr. Europe, North and South America, Cape of Good Hope, New Zealand, Falkland Islands.

Batrachospermum Thwaitesii, Dickie, n. sp.

"Main branches numerous, flagelliform, pinnated below, with numerous, alternate, flagelliform, simple ramuli; apices of rami naked. Whorls of ramelli crowded at base of rami, more distant toward the upper part, interstices with numerous moniliform simple ramelli."—*Dickie, MS.*
Thwaites! Herb. Per. C. Province, No. 17, Feb. 1870.

CONFERVACEÆ.

Cladophora anastomosans, Harv.

Ferguson!
Geogr. distr. Australia, Tongatabu.

Cladophora heteropsis, Kütz.

Ferguson!
Geogr. distr. Algeria, south of France.

Cladophora mauritiana, Kütz.

Ferguson !
Geogr. distr. Mauritius.

Cladophora valonioides, Sond.

Ferguson !
Geogr. distr. Australia.

Cladophora Thwaitesii, Harv.

Harvey ! No. 78.

Cladophora prolifera, Kütz.

Ferguson !
Geogr. distr. Mediterranean, Madeira, Barbadoes.

Rhizoclonium fontinale, Kütz.

Ferguson !
Geogr. distr. Europe.

Chætomorpha ærea, Dillw.

Ferguson !
Geogr. distr. Throughout all warm and temperate oceans.

Chætomorpha antennina, Kütz.

Kjellman ! Wittr. et Nordst. Alg. Exsicc. No. 318.
Geogr. distr. Indian, Pacific, and Atlantic oceans.

Chætomorpha clavata, Kütz.

Harvey ! No. 79. Ferguson !
Geogr. distr. Indian Ocean, Cape of Good Hope, West Indies.

Chætomorpha implexa, Kütz.

Ferguson !
Geogr. distr. Atlantic (English Channel), Mediterranean, Cuba.

Chætomorpha indica, Kütz.

Ferguson !
Geogr. distr. Indian Ocean, Persian Gulf.

Chætomorpha obscura, Kjellm.

Kjellman ! Wittr. et Nordst. Alg. Exsicc. No. 320.

Chætomorpha media, Kütz.

Harvey ! No. 98 (sub *Conferva media*, Ag.).
Geogr. distr. Indian Ocean.

Conferva affinis, Kütz.

Ferguson!
Geogr. distr. Europe, Anamallay, Neilgherries (*Falconer*!).

Conferva lucens, Harv.

Harvey! No. 97. Ferguson!

Conferva utriculosa, Kütz.; *β. ceylanica*, Wille.

Kjellman! Wittr. et Nordst. Alg. Exsicc. No. 430.

Œdogonium gracile, Kütz.

Ferguson!
Geogr. distr. Europe.

Œdogonium ochroleucum, Kütz.

Ferguson!
Geogr. distr. Europe.

ZYGNEMACEÆ.

Spirogyra Braunii, Kütz.

Ferguson!
Geogr. distr. Germany.

Spirogyra decimina, Müller.

Ferguson!
Geogr. distr. Europe, Asia, and America.

Spirogyra laxa, Kütz.

Ferguson!
Geogr. distr. Germany.

Spirogyra majuscula, Kütz.

Ferguson!
Geogr. distr. Europe.

Spirogyra tropica, Kütz.

Ferguson!
Geogr. distr. West Indies, Amazon.

Sirogonium ceylanicum, Wittr.

Kjellman! Wittr. et Nordst. Alg. Exsicc. No. 358.

IV. SCHIZOPHYCEÆ.

Scytonema tomentosum, Kütz.

Ferguson!
Geogr. distr. Europe.

Scytonema penicillatum, Ag.

Ferguson!
Geogr. distr. Blekingia.

Lyngbya majuscula, Hook.

Harvey! No. 84.
Geogr. distr. Mauritius, Socotra (*Balfour*!), Europe, North America, Bermuda, Martinique.

Trichodesmium erythræum, Ehrenb.

Ferguson!
Geogr. distr. Red Sea, Indian Ocean, Chinese Sea.

Hyphæothrix confervæ, Kütz.

Ferguson!
Geogr. distr. Germany.

Cylindrospermum macrospermum, Kütz.

Ferguson!
Geogr. distr. Throughout Europe.

IV.—*Contribution to the Knowledge of the Land-Planariæ.*

By Dr. D. Bergendal *.

In the orchid-house of the Botanic Garden in Berlin some *Bipalia* were observed last autumn. These have since greatly multiplied there, and I have made a careful investigation of them in the Berlin Zoological Institute. In 1878 Moseley described † *Bipalium kewense* from the hothouses of Kew Gardens. The form here observed seems to be identical with this, although the ground-colour of the back is usually more of an olive-green and the streaks are almost quite black. The head is comparatively small, with a dark crescent upon the upper surface. The mouth is situated further forward than in most other *Bipalia*, at the anterior end of the second third of the body. The animals found are all without any developed sexual organs. Only in one animal have I been able to interpret some small aggregations of cells in the sections as the rudiments of testes. Of the oviducts and *vasa deferentia* I have never observed any traces. In other *Bi-*

* Translated from the 'Zoologischer Anzeiger,' No. 249, April 18, 1887, pp. 218–224.

† Ann. & Mag. Nat. Hist. ser. 5, vol. i. p. 238.

palia an external sexual orifice can be easily detected even in small individuals; but in this case I have never succeeded in doing so even in larger animals. About 1 centim. behind the mouth one sometimes sees a slight impression, which perhaps might be regarded as an indication of this aperture.

The creeping movement of the worms is effected almost exclusively by the long and strong cilia which clothe the sides of the creeping-sole. The middle of the margin of this is set with short strong cilia, which, however, move very feebly. When creeping the worms are almost cylindrical; in fact the dorso-ventral axis is even longer than the transverse axis.

Multiplication by Transverse Division.

The number of sexually immature animals has greatly increased in the conservatory. Even in the autumn a great number of small worms were to be observed. Close examination showed that many of these presented no heads, and that in others the development of the heads was very unequal. Animals which were cut with a pair of scissors into several pieces did not die, but each piece formed a new head and mouth. In the renewal of the head a white point is first of all developed, and this gradually enlarges. At first the streaks of the body can usually be traced on to the young head-lobe. With the development of the papillæ and eyes the typical pigmentation also makes its appearance. The renewal of the pharynx can be noted from without during its progress by the fact that the middle dorsal streak becomes widened over the spot where the mouth is being formed.

I have also observed spontaneous transverse division. Three times animals from which I had cut away cephalic portions of considerable size constricted off corresponding pieces from the posterior extremity, and all the three pieces afterwards became regenerated. Once, under such circumstances, two posterior pieces were thrown off. On separating a *smaller* anterior portion I have observed no posterior abstriction; nor does such a thing always occur when larger pieces are cut off. It would seem that this depended upon whether the animals had been previously well nourished. These worms also divide without having received any external injury.

These *Bipalia* are generally found in the reversed pots upon which the pots with plants stand; and I once found in such a pot three pieces which had been produced from one worm by transverse division. The plants had not been moved for a fortnight or three weeks, and the fissional cica-

trices and the course of the streaks showed that the divisions had taken place at the utmost two days before. That all the three pieces were together in the same pot also makes it quite certain that the divisions had occurred recently and spontaneously. The cephalic and posterior portions were of equal length. In these divisions therefore the definite position of the mouth must be of great importance. When posterior pieces are cut away, however, no anterior abstrictions occur. The histological phenomena of regeneration cannot here be discussed.

The great quantity of small portions of worms which have been observed in the conservatories, although some of these, of course, are formed by injuries, show that these phenomena are by no means of rare occurrence, and therefore we find among the Land-Planariæ the same asexual mode of increase which has recently been demonstrated in the case of the freshwater forms.

The Excretory Vascular Apparatus.

Metschnikoff has already described two longitudinal trunks in *Geodesmus*. On the other hand, von Kennel has since investigated the same animal, and believes that the excretory canals are only vacuities in the parenchyma, and hence he regards it as a matter of course that in sections nothing can be seen of the few flagelliferous cells. Von Kennel's observations, however, seem chiefly to relate to the freshwater Planariæ; in these Lang and Iijima have since found regular excretory ducts.

The pigmentation and the numerous bacilli of the Land-Planariæ have hitherto hindered the study of this apparatus in the living animal. The heads in course of regeneration and still unpigmented, however, furnish a pretty good opportunity for such observations, which may also be made on the ventral surfaces of worms which have been divided by a horizontal cut with a pair of sharp scissors. Crushed preparations, which may be observed in weak solutions of chloride of sodium, also furnish very good results in favourable cases.

Hitherto I have been able to establish the following facts. The apparatus presents:—(1) ciliated funnels with a very strong flicker; (2) irregular but reticulated canals; and (3) longitudinal trunks. The last-mentioned are slightly undulated and are situated to the number of two or more on each side, dorsal and lateral to the ramifications of the intestine. Ventral longitudinal trunks have also been observed. The longitudinal trunks consist of large perforated cells and

exhibit thick cilia, the tuberculiform basal parts of which give the walls a reticulate appearance. From the longitudinal trunks issue straight transverse canals, which may be in part discharging and in part collecting canals. From the conditions found by Lang in *Gunda* we should expect a regular arrangement of these; but hitherto I have been unable to recognize it, although the small number of such transverse canals is decidedly in favour of it.

The longitudinal trunks are so deeply seated in the parenchyma that they can scarcely be observed except in sections. The reticular canals and the ciliated funnels, on the other hand, must be studied in the living tissue. In the head we see, both on the dorsal and the ventral side, a great number of canals situated near the surface, which run in curves or reticulately, and sometimes form nearly coil-like loops. In these canals I have frequently seen structures which I must for the present interpret as strong ciliations. They resemble the "flammes vibratiles" which Francotte has described in *Derostomum* and *Monocelis*. Metschnikoff also states something of the same kind with regard to the longitudinal canals of *Geodesmus*. I cannot regard them as phantasms produced by ciliary movement, because they are only to be seen here and there and because in crushed preparations I believe I have seen in exposed aquiferous vessels very long protoplasmic tongues pointed at both ends. They sometimes appear more membrane-like, and are then attached to the wall of the vessel by one margin. However, they can hardly represent those described by Francotte in *Polycelis*.

With the reticular canals the ciliated funnels are connected by very narrow longer or shorter canals, in which usually no phenomena of movement occur. The ciliated funnels are often placed in pits in groups of three or four together, and they present a large rounded excretory cell in which I have repeatedly observed vacuoles which emptied themselves into the funnel. Almost always there are ciliated funnels in the marginal papillæ of the head. I hope to be able hereafter to complete these exceedingly troublesome observations.

The Nervous System and Sense-organs.

Moseley regarded the nerve-trunks as a "primitive vascular system," but nevertheless believed that the nerves traverse them. Graff, von Kennel, Lang, and Iijima have shown that they are true nervous cords. In our *Bipalium* the sections of the nerve-trunks situated beneath the ramifications of the intestine are oval in transverse slices, and show a difference

of structure in different parts. In some places we see the septal (*Balkenbildung*) formation which is so much referred to; in others, the longitudinally running nerve-fibrils, cut across, are very distinct. Between these longitudinal trunks there are transverse commissures, which are very thin and often branched, which is probably the reason why Moseley and von Kennel did not see them. In older specimens, preserved in alcohol, of *Bipalium diana*, from the Zoological Museum in Berlin, I have also found these commissures. Near the head such commissures are particularly numerous. Further, strong arched nerves are emitted outwards, and these form a plexus under the skin. This plexus cannot be found everywhere; it is particularly well developed in the head and the fore part of the body. Such peripheral branches often start from the same spots as the transverse commissures, and at some of these points of ramification the dotted substance and the ganglion-cells become so numerous that one might almost describe it as a ganglion-formation *. No thickening of the longitudinal trunks was, however, observed. The ganglion-cells are large, have very large nuclei which stain rather faintly, and show two or three processes. The longitudinal nerves decrease very much in size in the caudal extremity; they curve towards one another and unite. In the cephalic portion is situated the flat and greatly extended brain, the formation of which by the union and thickening of two longitudinal trunks is to be recognized particularly distinctly in the hinder part of the brain. In the lateral portions of the brain we see great masses of dotted substance in transverse sections. Numerous ganglion-cells also occur in the brain, but their arrangement in the different parts cannot be described without figures.

Moseley has already stated that there are on the anterior margin of the head some papillæ, between which there occur little pits furnished with cilia. These papillæ, which are situated in a groove, are square in transverse section in *B. kewense*, and show an epithelium of rather small cells. The anterior surface of the papillæ is not beset with movable cilia; the lateral surfaces bound the passages leading to the pits and exhibit very strong cilia. The tissue of the papillæ consists in great part of muscular fibres, which give the papillæ great mobility. It is remarkable that we see in the papillæ no large nerve-trunks, nor is there any structure of the epithelium which would seem to indicate that they are sense-organs. The epithelial cells

* Iijima states that he found ganglia in the freshwater Planariæ, but that they possess but few ganglion-cells.

usually stain very strongly, and hence they cannot be well investigated. The observation of the living animal, however, fully establishes the interpretation of these papillæ as tactile organs.

In the above-mentioned pits, which are nearly spherical, the epithelial cells are much smaller, but they also stain strongly and can scarcely be washed out. From the anterior part of the brain, which rather forms a nervous plexus, strong nerve-branches run to the pits. The nerve-fibrils become thicker, and immediately beneath the pit we see a club-shaped bundle of long spindle-shaped and bacillar terminations of fibres. From these, small prolongations, which are of capillary fineness even under very high powers, run outwards between the cells of the epidermis. How they behave when there I cannot yet say. They are not connected with the rather strongly vibrating cilia which occupy the bottoms of the pits. Around this nerve-mass are placed larger, curved, fibriform granular structures, which pass to the lateral epithelial cells of the passages leading to the pits and agree in their appearance and reactions with the secretion-products of the glands. Motile cilia can hardly perhaps be interpreted as nerve-terminations, and therefore it seems probable that there are sense-hairs in the bottom of the pits among the cilia. The groups of strongly motile cilia of the freshwater Planariæ discovered by von Kennel have been regarded by Iijima as tactile organs, which can hardly be correct. They seem, however, to agree with these pits in *Bipalium*, and ought, perhaps, to be interpreted as olfactory organs or organs of taste.

Eyes occur in this species in enormous numbers. They form a zone of three or four rows near the margin of the head, and are also placed on the sides (not on the back) of the whole body, even to the hindermost end. The largest eyes are situated just behind the head. The eyes nearly agree in structure with those of the other Triclades. The crystalline cone is formed in the same way of several nucleated clavate cells. The nucleus seen by Moseley in the hindmost part of the eye belongs to the pigmentiferous cell. Nerves run to the eyes from the superficial nerve-plexus. Sometimes I have observed a gangliniform enlargement beside or in front of the eyes.

As regards other organs and structural conditions, I give here only the following remarks:—The whole body is provided with cilia. Between the ordinary epithelial cells we see here and there groups of slenderer bacilliform cells which may possibly be sense-organs. The rhabdites are of two

kinds, as I may remark in opposition to Iijima. Most of them are small and fusiform, but a good many are filiform, and more or less rolled up together. The two kinds are found together in the same cells, and both are also thrown off, for which reason I cannot regard them as developmental stages. As already stated, the bacilli are expelled under strong irritation, as, for example, when the animals are placed in Müller's solution, picric acid, picro-sulphuric acid, or chromic acid. In hardening them in corrosive sublimate, hot alcohol, or osmic acid, only the tips of a few bacilli usually make their appearance.

The musculature consists of an external layer of ring-muscles, external bundles of longitudinal muscles, and a great many internal longitudinal muscular fibres, to which are added dorso-ventral and transverse fibres.

In passing, I may state here that in *Bipalium diana* I have observed an encysted Nematode. In the unpaired limb of the intestine there was far forward the radula of a Gasteropod. I can confirm von Kennel's statements as to the occurrence and the mode of opening of the vitelline glands.

I hope in the course of the year to publish a more detailed memoir, furnished with figures, upon the points here noticed, and in this I shall furnish more complete statements as to the histological characters of the nervous system and the sense-organs, which cannot well be done here without figures. I will also give the necessary notices of the literature and comparisons with other forms. I have lately received well-preserved material of some other Land-Planariæ.

V.—*Descriptions of new Reptiles and Batrachians in the British Museum (Natural History)*.—Part III. By G. A. Boulenger.

Anniella texana.

Head less depressed, snout more rounded than in *A. pulchra*. Nasal shield semidivided, a horizontal suture extending from the nostril to the second labial; frontal twice as broad as long; anterior supraocular nearly as broad as the distance which separates it from its fellow; interparietal and occipital divided (anomalously ?) by a longitudinal suture; six upper labials—first very small, below the nasal, second largest and in contact with the præfrontal and a loreal, third

and fourth entering the eye; a narrow shield separates the third labial from the loreal; five lower labials. Twenty-eight scales round the middle of the body. No enlarged præanal scales. Tail ending obtusely, three eighths of the total length. Dark grey above, with three fine black longitudinal lines; sides and lower surfaces whitish.

From snout to vent 145 millim.; tail 85.

A single specimen from El Paso, Texas.

Eremias guineensis.

Snout moderate, obtusely pointed. Lower eyelid scaly. First upper labial in contact with the lower and posterior nasals and the anterior loreal; frontonasal separated from the rostral by the upper nasals; two præfrontals; two supraoculars; two series of small scales between the loreal and the anterior supraocular; a series of granules between the supraoculars and the supraciliaries; no occipital; no auricular denticulation; subocular bordering the lip, between the fourth and fifth upper labials; the three anterior pairs of chin-shields in contact. No gular fold; collar attached, distinct only at the sides. Scales granular, oval, sixty across the middle of the body. Ventral plates broader than long, in straight longitudinal and transverse series; ten longitudinal series, outer composed of smaller plates. Two consecutive enlarged præanals. The hind limb reaches the ear. One series of large and two of small subtibial plates. Twenty-one femoral pores on each side. Upper caudal scales strongly keeled. Head pale brownish above; three black bands, separated by narrower white ones, on each side along the temple and body to the groin, the two upper continued on the tail; the lower black band crosses the ear; a greyish, white-dotted vertebral band, edged on each side by a black line, which is separated from the broader black lateral band by a white line; limbs black above, with round white spots.

A single young specimen, from Brass, mouths of the Niger: from snout to vent 24 millim.; tail 36.

The origin of this specimen is of particular interest as filling up a gap in the distribution of the genus to which it belongs; no *Eremias* had yet been found on the west coast of Africa between the Sahara and the Congo.

Cacosternum, g. n. (Engystomatidarum).

Pupil horizontal. Tongue pyriform, free and notched behind. Palate toothless, without dermal ridges. Tympa-

num hidden. Fingers and toes free, tips not dilated. Outer metatarsals united. No præcoracoids; coracoids slender; sternum extremely small, cartilaginous. Diapophysis of sacral vertebra strongly dilated.

Cacosternum nanum.

Habit ranoid. Head of moderate size; snout rounded, without canthus rostralis; loreal region slightly concave; interorbital space broader than the upper eyelid. Fingers and toes slender, with obtuse tips and strong subarticular tubercles; first finger shorter than second; a rudiment of web between the toes; a round inner metatarsal tubercle; no tarsal fold. Tarso-metatarsal articulation reaching the tip of the snout. Skin smooth; a strong fold from the eye to the shoulder. Pale olive or greyish above, with darker spots, forming more or less distinct cross-bands on the limbs; a dark temporal spot, edged with whitish inferiorly; throat and lower surface of legs grey, with a whitish network; belly whitish, with a few large grey spots, and on each side a few smaller black ones. Male with a subgular vocal sac.

Two male specimens, measuring 19 millim. from snout to vent, from Vleis, Kaffraria; presented by F. P. M. Weale, Esq.

Bufo Muelleri.

Closely allied to *B. pulcher*, Blgr. Crown without bony ridges; snout short, obliquely truncate, with perpendicular lores; interorbital space broader than the upper eyelid; tympanum very indistinct. Fingers rather long, somewhat widening and truncate at the end, first much shorter than second; toes rather short, webbed to the tips, which are slightly swollen; metatarsal tubercles two, flat and very indistinct; the membrane bordering the inner toe extends as a fine fold along the tarsus. The tibio-tarsal articulation reaches the anterior border of the orbit. Skin nearly smooth above, granular inferiorly; no parotoids. Black above, with lighter wavy lines or marblings, and with round white dots on the sides and limbs; throat and belly marbled with brown. Male with a subgular vocal sac.

From snout to vent 30 millim.

A single male specimen from Mindanao, Philippine Islands. Received from the Natural History Museum of Basle. I have named the species in honour of my friend Dr. F. Müller, the learned curator to whose efforts is due the prominent position now held by the Herpetological Collection of the Basle Museum.

Hyla Copii.

Tongue circular, nicked and free behind. Vomerine teeth in two short transverse groups in the middle between the choanæ. Head broader than long, rather strongly depressed; snout rounded, as long as the diameter of the orbit; canthus rostralis very feebly marked; loreal region concave; interorbital space as broad as the upper eyelid; tympanum very distinct, half the diameter of the eye. Fingers free, toes three-fourths webbed; disks smaller than the tympanum; subarticular tubercles moderate; a very distinct fold along the inner side of the tarsus. The tibio-tarsal articulation reaches the eye. Upper surfaces with small smooth warts; lower surfaces (gular sac included) closely granulate; a strong fold across the chest. Greyish olive above, with more or less distinct darker spots or marblings on the head and body, and cross-bands on the limbs; hinder side of thighs with small brown mottlings; front half of throat brown. Male with a large external gular vocal sac.

From snout to vent 42 millim.

Two male specimens from El Paso, Texas.

This species, which I have pleasure in dedicating to the celebrated American herpetologist, resembles *H. versicolor*, from which it is at once distinguished by the absence of web between the fingers.

VI.—*A List of fifty* Erotylidæ *from Japan, including thirty-five new Species and four new Genera.* By George Lewis, F.L.S.

The first descriptions of Japanese Erotylidæ were published by Mr. G. R. Crotch in 1873; and since then, as the country has been gradually opened for inland travel, species have been added from time to time until the present day, when the list contains fifty species. Marseul's Catalogue for Europe gives twenty-three species, and Heyden's for Siberia twenty-four; but the last and the present list can have no pretention to completeness. The majority of the known Erotylidæ are from the New World.

Japan is a country which is in many ways favourable to the group, as the damp elevated forests which occupy large areas in the mountainous districts produce quantities of fungi from the early days of spring to the last days of autumn.

Edible mushrooms are an article of commerce, and are largely exported to China, being at the same time one of the sources of revenue to the government, which in many districts has the monopoly of the forests where they grow. In May 1880, when I first went into the forests in the Hakone district, I found large oaks felled for the purpose of mushroom-culture; the horizontal trunks were covered with mushrooms throughout their length from spawn sown, purposely I believe, in the summer previous. I had filled several large sheets and captured as many new species before I was warned that government property was being destroyed and the penalties for such conduct severe. But in the wilder forests, which are rarely trodden even by the native peasants, fungi are equally plentiful, and there is no lack of hunting-ground for the entomologist.

Most of the Erotylidæ in Japan are imagos before the middle of June, and very few survive at the end of the year to hybernate. An exception is *Dacne picta*, which may be found under *Planera*-bark any day in January close to the bund at Yokohama. In the second and fourth stages they are all fungivorous, and during pupation are dependent on the moisture in the plants in which they remain imbedded for their preservation. In temperate climates the Erotylidæ often appear to be of periodical occurrence; but if this is not strictly true the collector is at any rate greatly dependent on fortuitous circumstances, such as season and place, for the capture of the rarer species, and these contingencies sometimes occur only at long intervals. In Kioto, within the temple compound of the Nishi Honwanji, I found on the 17th June, 1881, *Aulacochilus japonicus* in the greatest profusion on fungi on some upright cherry-poles, and numerous specimens were crushed on the pathways; and this was not a remarkable phenomenon considering the habits of the family.

There is one character in the family to which it is necessary specially to allude. In a long series of specimens the largest examples are invariably males. I have one example of *Encaustes prænobilis* which measures 35 millim., and the smallest male measures 30 millim. The first is perhaps the largest Erotylian in any cabinet, and I can still remember the muscular sensation its weight caused as it feigned death in my hand when I took it off an old beech at Nikko. The largest female measures 31 millim., and there are several only 16. In *Eudæmonius tuberculifrons* and *Neotriplax atrata* the larger size of the males is conspicuous, and it is evident from the material in hand that this characteristic is a family trait. In the Languridæ the females are the larger,

and this is the rule also in the Chrysomelidæ. In the wood-feeding Lucanidæ the males again are the largest, and this character is a family one; it is not generic or specific. In the Cerambycidæ it is not constant either way, the female is smallest in *Monohammus grandis*, Waterhouse, but the males are more usually so.

I have placed *Microsternus* and *Megalodacne* among the Dacnini because the tarsi are visibly five-jointed. The species placed under Encaustini have no true prosternal keel.

There is only one synonym to record, which is very satisfactory.

List of Species, arranged generically and according to their specific similitude.

DACNINI.

Dacne japonica, *Crotch.*
—— picta, *Crotch.*
—— zonaria.
—— fungorum.
Microsternus perforatus, *Lewis.*
—— Crotchi.
—— tricolor.
—— higonius.
Megalodacne bellula, *Lewis.*

ENCAUSTINI.

Encaustes prænobilis, *Lewis.*
Episcapha Fortunei, *Crotch.*
—— Gorhami, *Lewis.*
—— taishoensis, *Lewis.*
—— hamata, *Lewis.*
Renania atrocyanea.

TRIPLACINI.

Neotriplax atrata.
—— Lewisii, *Crotch.*
—— biplagiata.
—— pallidicincta.
Cyrtotriplax sobrina.
—— centralis.
—— pantherina.
—— latifasciata.
Cyrtotriplax nigropunctata.
—— pallidiventris.
—— cenchris.
—— maculifrons.
—— discalis.
—— rufipennis.
—— niponensis, *Lewis.*
—— solivaga.
—— circumcincta.
—— tripartiaria.
—— basalis.
—— similis.
—— ruficornis.
—— connectens.
Triplax gracilenta, *Solsky* [*sibirica*, Crotch].
—— devia.
—— ainonia.
—— sufflava.
—— lætabilis.
—— canalicollis.
—— discicollis.
—— japonica, *Crotch.*
—— atricapilla.
Eudæmonius tuberculifrons.

EROTYLINI.

Aulacochilus Bedeli, *Harold.*
—— japonicus, *Crotch.*
Satelia scitula.

The three following genera have tarsi with five distinct joints:—

Dacne japonica.

Dacne japonica, Crotch, Ent. Mon. Mag. ix. p. 188 (1873).

This species is not very common; it has been taken at

Nagasaki, Nikko, and Sapporo. It varies in size from 3 to $4\frac{1}{2}$ millim.

Dacne picta.

Dacne picta, Crotch, *l. c.* p. 188 (1873).

Common at Nagasaki and near Yokohama. Found under the bark of *Planera* in winter.

Dacne zonaria.

Elongato-ovalis, nigra, nitida; elytris macula humerali tarsisque rufis. L. $3\frac{1}{4}$ mill.

Densely black and shining; head and thorax sparsely and somewhat coarsely punctate, the latter strongly marginate laterally; elytra punctate-striate, with punctures in lines down the interstices, punctures rather finer than those of thorax, one red belt, oblique, touching the edge only at the humeral prominence at the base, leaving a black margin both at external and sutural edges; the hamate pattern, so common in the family, is rather broad at the scutellum. The antennæ, sometimes obscurely reddish at the base, are somewhat long and the club somewhat free; the tarsi and knees are reddish. Beneath, the head and prosternum are coarsely and rather rugosely punctured; the intercoxal lines reach the base of the prosternum; the mesosternum is rather finely punctured.

The colour separates this species from the other Japanese species, and the antennæ are proportionally longer, with the club lax. It is also unlike any other species I know.

Found at Kiga, Miyanoshita, and Nikko abundantly; Konosé, Fukushima, and Sapporo are other localities for it.

Dacne fungorum.

Oblonga, nigra, nitida; elytris macula humerali, capite, antennis pedibusque rufis. L. 3 mill.

Oblong, black and shining; head and thorax sparsely and rather coarsely punctate, the first red, the latter black, with lateral margin obscurely piceous and anteriorly narrowly concolorous with head; elytra punctate-striate, interstices somewhat similarly punctured, with a red irregular blotch at the humeral angle which touches the edge only at the base; antennæ, legs, and tarsi wholly red. Beneath, the prosternum is very minutely rugose and punctured somewhat similarly to the metasternum; the intercoxal or prosternal striæ advance anteriorly a little beyond the coxæ, and posteriorly touch

the base of the prosternum; the mesosternum is more coarsely punctured, and the abdomen is piceous. One specimen, evidently a variety, is obscurely 4-maculate.

This insect is relatively much broader than *D. zonaria*; the humeral spot agrees fairly well with that of *D. bipustulata*, Thunb., from Europe and Siberia, but it is larger and broader.

I have only six specimens of this species—five (including the variety) from Nikko, the other from Horobetzu, in Yezo.

Microsternus.

Microsternus, Lewis, Ent. Mon. Mag. xxiv. p. 3 (1887).

Form rather elongate, convex; eyes granulate, moderately prominent; thorax with large punctures, leaving a space in front of the scutellum smooth; elytra finely punctate-striate, pattern varied; antennæ rather robust, second and third joints nearly same length, fourth to eighth moniliform, all same length, eighth rather thicker, the club is compressed and oval; last joint of maxillary palpus but little enlarged; prosternum coarsely sculptured at sides, with the central process raised, marginate and triangular, the median area more or less smooth; the mesosternum is very transverse, and, except under a high power, looks like a margin to the metasternum; tarsi distinctly five-jointed, the fourth smaller than the third, and not padded. In two species, *M. Ulkei* and *higonius*, the thorax is laterally sulcate, the furrow being deepest anteriorly.

Microsternus perforatus, Lewis.

Microsternus perforatus, Lewis, Ent. Mon. Mag. xxiv. p. 3 (1887).
Episcapha perforata, Lewis, *l. c.* p. 140 (1883).

Very similar to *M. Crotchi*; it is larger and darker in colour, and the fasciæ are more defined, with the branch that spreads upwards round the hamate pattern narrower, and the humeral spot is larger and more rotundate. As in *M. tricolor* and *Crotchi* the thorax is simply marginate at the sides, not sulcate.

Taken on Oyayama and at Yuyama, in Higo. Two specimens.

Microsternus Crotchi.

Elongato-ovatus, piceo-brunneus, capite tenui et parce punctato; thorace utrinque parum grosse punctato, ante scutellum lævi; elytris tenuiter punctato-striatis, transversim bifasciatis; antennis pedibusque obscure nigris. L. 5 mill.

Head irregularly punctate, with two oblique impressions between the antennæ; thorax marginate laterally, coarsely punctate, somewhat densely at the sides, sparsely in the middle, with a transverse space before the scutellum smooth; the elytra are finely punctate-striate, the interstices with smaller punctures scattered irregularly; at the base there is a broad yellowish fascia, which leaves a humeral spot, and the usual hamate pattern behind the scutellum, black, and another before the apex, which leaves the suture and outer edge black. Beneath, the sternal plates are similar to those of *M. tricolor*, as noted below.

Two specimens, from Nishimura in Yamato, are all I obtained.

Microsternus tricolor.

Elongato-ovatus, obscure rufo-brunneus, capite thoraceque parce punctatis; elytris tenuiter punctato-striatis, interstitiis inconspicue puncticulatis, luteo-fasciatis; pedibus brunneis; antennis infuscatis. L. 4 mill.

Head and thorax irregularly and sparsely punctate, reddish brown above, but darker beneath, marginate at the sides; elytra with a black humeral spot surrounded by a yellow band, which is narrow at the outer edge, but posteriorly about as broad as the black spot; in the middle of the elytra is a broad irregular black band which, on reaching the fourth stria, becomes concolorous with the head and thorax, and at the second stria extends up to the scutellum; before the apex is a second black band with even edges, and it is separated from the central band by a yellow fascia, broadest at fourth stria; apex reddish yellow. The prosternal process is triangular, marginate and impunctate; the sides of the prosternum are thickly and coarsely granulate; mesosternum inconspicuous.

I obtained five examples at Yuyama, in Higo, in May 1881.

Microsternus higonius.

Oblongo-ovatus, piceus; thorace rufo maculato; elytris punctato-striatis, rufis, nigro 6-maculatis; antennis pedibusque rufo-brunneis. L. $2\frac{1}{2}$ mill.

Head and thorax with large scattered punctures, first wholly piceous, second with a longitudinal reddish mark on each side on the disk in a line behind the eyes; the thorax has a broad, raised, lateral margin, parallel to which is a somewhat deep furrow; in front of the scutellum is a crenulate arched line (corresponding a little to the lines common in *Abræi*),

which divides the smooth space from the punctate portion; the elytra are red, with a black spot, not well defined, at the humeral angle, a second larger and formed as a band near the middle, commencing in the interstice of the second and third striæ and touching the outer edge, a third, the size of the humeral one, on the disk before the apex, covering the space from the second to the fifth stria, the interstices are inconspicuously punctured and the scutellum is semicircular and smooth.

The smooth space before the scutellum has been given as a generic character, and in the present insect the punctures bordering it are obliterated posteriorly, which gives an appearance as of a crenulate arch; the sides of the thorax are more deeply sulcate than in *Microsternus Ulkei*, Crotch.

This very peculiar insect is unfortunately unique. It was taken at Yuyama, in Higo, June 1881.

Megalodacne bellula, Lewis.

Megalodacne bellula, Lewis, Ent. Mon. Mag. xx. p. 139 (1883), xxiv. p. 3 (1887) (sterna figured).

In fungi on the beech.

The following genus has the prosternal keel broad and ill-defined, and only visible between the coxæ:—

Encaustes prænobilis, Lewis.

Encaustes prænobilis, Lewis, Ent. Mon. Mag. xx. p. 139 (1883).

Found in the beech-forests of all the islands.

In the two following genera there is no prosternal keel:—

Episcapha Fortunei, Crotch.

Episcapha Fortunei, Crotch, *l. c.* p. 188 (1873), p. 140 (1883).

On fungi on *Abies* only; fairly common.

Episcapha Gorhami, Lewis.

Episcapha Gorhami, Lewis, *l. c.* p. 140 (1883).

Abundant in the elevated forests.

Episcapha taishoensis, Lewis.

Episcapha taishoensis, Lewis, *l. c.* p. 79 (1874), p. 140 (1883).

Found in Yezo in 1880 and in Higo in 1881; it is not rare.

Episcapha hamata, Lewis.

Episcapha hamata, Lewis, *l. c.* p. 140 (1883).

Not found by myself.

Renania.

Antennæ as long as the head and thorax; first joint stout and short, second and fourth to seventh moniliform and equal in length, third one half longer than fourth, eighth very slightly triangular, ninth and tenth compressed and transversely triangular, eleventh rotundate, the last three forming a rather lax club; maxillary palpi short and not dilated; head moderate, with eyes slightly prominent, and rather coarsely granulate; thorax about one third wider than long, with anterior angles a little produced; elytra about four times as long as the thorax, subparallel; scutellum transverse; legs rather long; fourth joint of tarsus very small. Prosternum marginate at the coxæ only, widening out anteriorly without a keel or raised portion. I do not see any sexual differences; the mesosternum is rather large, and is, with the prosternum, formed much as in *Episcapha*, near to which genus *Renania* may be placed. The name of the brilliant French *littérateur* has been adopted.

Renania atrocyanea.

Subelongata, atro-cyanea; capite thoraceque sat parce punctulatis; elytris punctato-striatis. L. 6–6½ mill.

Rather elongate, above dark cyaneous, beneath more obscure; head feebly biimpressed between the antennæ, rather more thickly punctured before than behind; thorax somewhat similarly punctured, with two shallow foveæ at the base, near the middle of each elytron; the margin has a fine stria behind, and is strongly marginate at the sides; the anterior angles are a little produced, with a small and very distinct fovea in the centre of the interstice; the legs are rather elongate and simple in both sexes.

I obtained eleven examples of this species incidentally while beating brushwood in June, but could not trace it to any fungus. One example was found under bark on Oyama in December 1880; Chiuzenji and Kashiwagi are the other localities for it.

Neotriplax (type *atrata*, Lewis).

Antennæ about the length of the thorax, first and second

joints short and stout, third as long as fourth and fifth together and more slender, fourth to eighth moniliform, seventh and eighth enlarging, ninth to eleventh transverse, compressed, and together forming an oval club; last joint of the maxillary palpus triangularly dilated and rather robust; head robust; eyes very moderately prominent, rather coarsely granulate; thorax as broad again as the length, with narrow reflexed margins; legs in male rather robust, with tarsi dilated, first and second joints transversely triangulate; female, legs and tarsi slender. Prosternum marginate before and behind, without true striæ, and distinctly constricted between the coxæ; mesosternum wide and moderately transverse.

Neotriplax atrata.

Oblongo-ovata, convexiuscula, nigra, nitida, parce punctulata; elytris punctato-striatis, interstitiis punctulatis; antennis pedibusque nigris. L. $5\frac{1}{2}$–$7\frac{1}{2}$ mill.

This species is congeneric with and very similar to *Cyrtotriplax Lewisii*, Crotch; but it is larger and broader and wholly black. Both species have a semicircular line between the antennæ, which divides the epistoma from the forehead. The general facies, distinct foliation of the club of the antennæ, the dilated tarsi, and the absence of true prosternal lines are sufficient to remove it from *Cyrtotriplax*, of which genus *bipustulata*, F., is the type.

This insect was found not uncommonly in localities where the beech and oak grow in elevated forests; and I obtained it in all the islands. It varies much in size.

Neotriplax Lewisii.

Cyrtotriplax Lewisii, Crotch, Ent. Mon. Mag. ix. p. 189 (1873).

I once found this in great profusion at Nagasaki in fungoid growth on rails, as recorded by Crotch. In 1880 I found it not uncommonly in the environs of Yokohama, and in the autumn, about October 29th, I saw a large assemblage of it near Nikko.

Neotriplax biplagiata.

Ovata, nigra, nitida, macula humerali sanguinea; elytris punctato-striatis, interstitiis puncticulatis. L. $3\frac{3}{4}$ mill.

Densely black, except the antennæ, palpi, and humeral spot, which occupies the interstices of the fifth, sixth, and seventh striæ, but does not touch the edge; the antennæ are piceous and the palpi flavous. The prosternum is rather

broad posteriorly, narrowed at the coxæ, the striæ turn outwards at the coxæ, nearly touching the sides of the thorax; the anterior edge of the prosternum is marginate. The antennæ have the two basal joints rather large, the third to eighth small, and the club is compressed and oblong-ovate.

I took an example at Miyanoshita and a second on Oyama in May 1880, and both appear from the tarsi to be females.

Neotriplax pallidicincta.

Ovata, obscure nigra, nitida; elytris pallidicinctis; antennis pedibusque infuscatis. L. $3\frac{1}{4}$ mill.

Head rather sparsely, evenly punctured, thorax with fine punctures on the disk and before the scutellum, more coarsely punctate on each side of base; elytra punctate-striate, interstices irregularly puncticulate, the outer edge rather broadly yellow, the band being double the breadth at the humeral angle, where it includes the fifth stria, and the band widens again before the apex; the abdomen is pitchy brown.

This and the preceding species, if the males are known to me, are without the conspicuously dilated tarsi seen in *N. atrata* and *Lewisii*; but I do not consider the material at hand sufficient to decide the question. The prosternum is formed on the same plan in the four species.

Fukushima, two specimens, July 1881, also probably females.

Cyrtotriplax sobrina.

C. consobrinæ proxime affinis, sed paulo major; nigra, nitida; antennis pedibusque nigris; elytrorum macula sanguinea tripartita. L. $4\frac{1}{2}$–5 mill.

This is the Japanese representative of *C. consobrina* and *bipustulata*. The punctuation is the same, but the red elytral fascia is divided into three parts; a broad sinuate band, touching the outer edge, extends inwards to the second stria, leaving the suture black, and then passes upwards to the base of each elytron, occupying the space of the interstices between the third and fifth striæ. The legs and tarsi are longer, and the tibiæ, especially the middle pair, more dilated. The prosternal striæ are hamate anteriorly, and terminate at a point distant from one another. In *C. consobrina* the prosternal striæ tend throughout their length to converge, and do nearly meet in front.

Cyrtotriplax centralis.

Ovata, nigra, nitida; ore, antennarum funiculo tarsisque rufis;

capite parum grosse punctato, utrinque rufo; scutello nigro; elytris basi rufis, apice nigris, in medio nigro-punctatis. L. 4½ mill.

This species is a true *Cyrtotriplax*, and in many characters is similar to *C. sobrina*: the thorax is much less wide, the lateral margin more robust; the club of the antennæ alone is black, the head is triangularly black in front, red at the sides; the elytra are red at the base, and in the central region this colour extends halfway down, enclosing a round black spot immediately below the scutellum; at the sides of the elytra the black colour encroaches on the red to the middle of the fourth interstice. The prosternum is rugosely punctate, with striæ widely separate and not hamate; the mesosternum is red at base.

Captured between Nikaido and Kashiwagi, June 15, 1881.

Cyrtotriplax pantherina.

Ovata, rufo-testacea, nigro maculata; antennis pedibusque testaceis. L. 4½ mill.

Red; head and thorax somewhat densely punctate; head with a black oblong spot between the eyes, two larger spots on thorax, touching its base at centre of each elytron; scutellum black; elytra with two large black transverse spots at the edge below the humeral angle and two spots behind the scutellum, confluent at the suture; the apical portion has a very wide irregular band which leaves the ends of the elytra alone red. The prosternal lines are anteriorly hooked and nearly converge; the fore part of the prosternum and the metasternum are dark-coloured.

A good series was brought from Oyayama, near Kumamoto, in Higo, June 1881, by a native collector.

Cyrtotriplax latifasciata.

Ovata, nigra, nitida, capite basi rufo, scutello nigro; elytris late bifasciatis; antennis (basi excepta) pedibusque nigris. L. 3½ mill.

Black and shining; head and thorax rather finely punctulate, former transversely red at base, latter wholly black; the elytra are black, with a broad fascia at the base, apically irregular, broadest between fifth and sixth striæ, narrowest at third; the second band is broadest at the same point, the anterior one is slightly the wider, and the extremities of the elytra are reddish; the posterior line of the posterior red band is not irregular; the legs are black, with the tarsi red.

The prosternal striæ are turned inwards anteriorly, but are not hamate, and are widely separate.

Taken in Higo.

Cyrtotriplax nigropunctata.

Ovata, nigra, nitida, punctata; ore, antennarum funiculo tarsisque piceis; elytris rufis, apice, punctis regioneque scutellari nigris. L. $3\frac{1}{2}$ mill.

Black; head rather more coarsely punctured than thorax; elytra red, with a large semicircular spot round the scutellum and two small spots transversely placed to each other before the middle of each elytron, one on the elytral edge, the other on the fifth and sixth striæ, black; the apices of the elytra for about one third of their length are also black, the pattern ending in two semicircular edges, divided into two parts at the fifth stria. The prosternal striæ curve inwards anteriorly, but are widely separate from each other.

I took this at Miyanoshita in May 1880.

Cyrtotriplax pallidiventris.

Ovata, nigra, nitida, ore abdomineque rufo-testaceis. L. 4 mill.

Ovate, black and shining; head and thorax rather thickly punctured, and seen under the microscope to be minutely strigose; base of the head obscurely pitchy red; the elytra very distinctly punctate-striate, with the interstices nearly smooth; the legs are rather robust. Beneath, the pro- and mesosternum are rugosely punctate, the fourth posterior segment of the abdomen reddish yellow; the prosternal lines continue narrowly round the base, and gradually approach each other anteriorly, but owing to the rugose surface it is difficult to see whether they meet or not.

I captured three examples near the waterfall at Chiuzenji, Aug. 22, 1881.

Cyrtotriplax cenchris.

Late ovata, rufa; elytris apice infuscatis, antice nigro 4-maculatis. L. $2\frac{3}{4}$–3 mill.

Rather broadly ovate, red; head punctate, thoracic punctures finer and more scattered; elytra wholly punctate, the striæ being indistinct owing to a similar sculpture of the interstices; each elytron has two black spots (smaller and larger in different specimens), one below the humeral angle, with the second posterior to it, the apex being infuscate, as though a third spot were obsolete; round the two black spots the colour is sometimes yellowish, giving a tricolour appear-

ance to the specimens; but this is not always the case; the club of the antennæ is infuscate. Beneath the body is wholly red, and anteriorly the prosternal lines are widely separate and very slightly bent inwards. Legs red and not robust.

I took a small series at Fukushima, July 28, 1881, one at Kashiwagi in June, and later I received it from Higo.

Cyrtotriplax maculifrons.

Late ovata, nigra, nitida; capite basi transversim rufo; elytris distincte punctato-striatis, interstitiis sparsim punctulatis, rufis, antice bimaculatis, postice fasciis duabus latis communibus; antennarum funiculo tarsisque rufis. L. 3–3½ mill.

Rather broadly ovate, black; head and thorax equally punctured, the first red between the eyes, the second wholly black; scutellum and elytra red, latter with two large, rather transverse, black spots before the middle and beginning inwardly in the centre of the second interstice, and covering five striæ, before the apex is a large black spot common to both elytra, being joined at the suture, which leaves the apex and a narrow marginal space red. Beneath, all the abdominal segments are red; the prosternum is broad at the base, the striæ leaving a triangular space, widest at base; anteriorly the striæ are incurved, but terminate moderately apart.

Found on Oyama, May 25, 1880, and two others came from Higo in the spring of the following year.

Cyrtotriplax discalis.

Ovata, nigra, nitida; antennis tarsisque piceis, scutello rufo; elytris punctato-striatis, interstitiis subtiliter punctulatis, rufis, posticis disci late nigris. L. 3–3¼ mill.

Ovate, black; head more coarsely punctured than thorax, the latter with punctures much scattered, and under the microscope the surface is seen to possess a minute mosaic-like sculpture; the elytra are red at the base for nearly one third of their length, when the disk posteriorly becomes black, leaving only a narrow margin red. Beneath, the surface is sculptured minutely, like the thorax; the last segments of the abdomen have reddish margins; the mesosternum more transverse than usual in the genus; prosternal striæ straight at sides and anteriorly slightly turned inwards.

Taken at Nikko and Kashiwagi. Two examples only.

Cyrtotriplax rufipennis.

Ovata, nigra, nitida; elytris rufis, distincte punctato-striatis, interstitiis subtiliter punctulatis; subtus abdomine marginali testaceo. L. 4 mill.

Black; head and thorax sparsely and not coarsely punc-

tate, the first narrowly red at base, both very minutely strigose under a high power, the second with lateral margins piceous; scutellum and elytra red, the latter distinctly punctate-striate; interstices with fine, somewhat irregular punctures, although sometimes appearing to be set in rows; first three joints of antennæ and club piceous, intermediate joints sometimes and tarsi always reddish. Prosternum rather rugose, striæ straight, turned inwards anteriorly, but fairly wide apart; abdominal segments two to five margined with yellow posteriorly.

Three examples, on Rakuwayama, near Hitoyoshi, May 3, 1881.

Cyrtotriplax niponensis, Lewis.

Cyrtotriplax niponensis, Lewis, Ent. Mon. Mag. xi. p. 78 (1874).

This species is wholly black, except the base of the antennæ, the palpi, and coxæ, which are pitchy red. The prosternal lines are slightly curved at the tips. It varies in size from 3 to 4 millim., and occurs commonly at Nikko and Miyanoshita; and I obtained it also sparingly in all the islands, including Sado. Reitter records it from Siberia.

Cyrtotriplax solivaga.

Ovata, nigra, nitida, ore antennisque piceis; elytris in medio obscure rufo-punctatis. L. $4\frac{1}{4}$ mill.

Black; head and thorax evenly and somewhat sparsely punctured (minutely strigose under microscope); elytra rather strongly punctate-striate, with interstices very finely and sparsely puncticulate. Below the humeral angle on the sixth stria there is an obscure reddish spot. Prosternal process raised and triangular, the stria meeting at the anterior edge, thus Δ, completely enclosing the space between; and this last character will distinguish it from any other Japanese species at present known.

I obtained this in the beech-forest to the south of the lake at Hakone, April 23, 1880.

Cyrtotriplax circumcincta.

Late ovata, nigra, nitida, punctata; elytris parum latis, flavo-rufis; antennis pedibusque nigris. L. 4 mill.

Black and shining; head and thorax somewhat densely but not coarsely punctate, minutely strigose (very distinctly so under microscope); elytra punctate-striate, interstices wholly punctulate, at the base, outside the fourth stria, red, after the middle this red margin narrows to the seventh stria. Beneath, the anterior portion of the metasternum and first segment of abdomen are transversely red; the four poste-

rior segments of the latter are also red; the prosternal process is rather raised in front, and the striæ resemble those of *C. niponensis*.

Three specimens, taken at Miyanoshita, May 1880.

Cyrtotriplax tripartiaria.

Ovata, nigra, nitida, ore antennisque piceo-rufis; capite thoraceque parum dense punctatis; scutello rufo; elytris antice rufis, postice nigris. L. 4 mill.

Black, shining; thorax evenly and somewhat densely punctate; scutellum smooth and red; elytra, base wholly red, apex wholly black, each colour occupying about half the elytral area; behind the scutellum the black encroaches on the red, at the fifth stria and outer edge the red encroaches on the black. Beneath, the sides of the abdomen are broadly red, also the tarsi; the prosternal lines are anteriorly hamate.

I possess four specimens from Higo.

Cyrtotriplax basalis.

Breviter ovata, nigra, nitida; antennis pedibusque dilutioribus, capite basi rufo thoraceque parum dense punctatis; scutello nigro; elytris basalibus rufis, punctato-striatis, interstitiis obscure puncticulatis; tibiis robustis. L. $3\frac{1}{4}$ mill.

Black and shining; head and thorax evenly and somewhat densely punctured; neck reddish; elytra punctate-striate, punctures rather fine, interstices very finely puncticulate; the region behind the scutellum is piceous to the breadth of one interstice; after the first stria a red band begins, which widens out on the interstices on each side of the fifth stria and touches the outer edge. Beneath, the elytral fold is red at the humeral angle, and the anterior edge of the prosternum is transversely obscure yellow; the prosternum is minutely rugosely strigose, the sculpture assuming the mosaic form on the metasternum; the prosternal lines are bent inward at their apex.

I swept one example of this very distinct species on Oyama, May 24, 1880.

The following species have black or blue-black elytra and the thorax wholly red or nearly so, and superficially appear to be like an ordinary *Triplax* except in being convex:—

Cyrtotriplax similis.

Oblongo-ovata, rufa, nitida; elytris nigris, punctato-striatis; antennis basi pedibusque rufis. L. 5 mill.

Red; head and thorax sparsely and rather evenly punctured, the punctures at the base of the head being relatively large; the scutellum is obscurely red, broadly margined at the sides with black; the elytra are somewhat finely punctate-striate,

with interstices finely and sparsely punctulate; the antennæ have the basal joints red, five to eight darker and the club blackish; legs red, with the tibiæ rather robust, the middle pair angulated at the base. Beneath wholly red; prosternum with six or seven punctures, with the stria slightly curved anteriorly.

I took only five examples at Nikko and Kashiwagi.

Cyrtotriplax ruficornis.

Oblongo-ovata, capite elytrisque nigris; antennis pedibusque rufis. L. $4\frac{1}{4}$ mill.

Head and thorax evenly and sparsely punctured, punctures at the base of the head not large, as they are in *C. similis*; head, elytra, meso- and metasterna black, the rest red; the prosternal lines are very long and nearly touch the anterior edge; the prosternal process is somewhat raised and truncate in front; the tibiæ are not robust or angulate, as in the last species.

One example taken at Nikko and another at Kashiwagi.

Cyrtotriplax connectens.

Oblongo-ovata, capite elytrisque nigris, pedibus flavis. L. $3\frac{3}{4}$ mill.

Head and thorax sparsely and evenly punctate, head black, antennæ red with club infuscate; thorax red, narrowly black behind the neck and in front of the scutellum; scutellum and elytra black, latter punctate-striate, the interstices with well-marked punctures, often in rows. Beneath, the thorax is red with infuscate base; abdomen broadly margined with obscure yellow, the rest black; prosternal lines anteriorly very fine and disappearing gradually in front of the coxæ; the mesosternum has a few large punctures; metasternum with finer and more numerous punctures; legs and palpi yellow, former not robust.

Ikenchaiya, June 22, 1881.

The specific name is chosen because the species leads out of *Cyrtotriplax* into *Triplax*. *Triplax gracilenta* is a very similar species to this, and I am not sure, when a fair revision of the family is made, the two genera will be declared distinct.

Thus it appears from the material now at hand that *Cyrtotriplax* has species which link it very closely with *Triplax*; in other words, it may be said that the convexity of the forms in the first genus is not always pronounced.

Triplax gracilenta.

Triplax gracilenta, Solsky, Deutsche ent. Zeit. p. 23 (1879).
Triplax sibirica, Crotch, Revis. p. 90.

Oblongo-ovata; thorace flavo, antice et postice anguste infuscato; antennis pedibusque flavis. L. $3\frac{3}{4}$ mill.

Head black, punctate; thorax flavous, with a narrow band

before the scutellum and another behind the neck, infuscate; punctures of thorax finer on the disk than on the sides; scutellum black, with a very few minute punctures; elytra punctate-striate, interstices irregularly punctate, punctures most visible between the suture and the first stria.

Monsieur Hiller obtained this at Hagi, near Shimonoseki, and I took six specimens from a fungus on *Salix*, at Nowata, June 22, 1880.

Triplax devia.

Oblongo-ovata, nigra; thorace rufo, antice et postice rotunde nigro maculato; antennis tarsisque infuscatis. L. $3\frac{3}{4}$–4 mill.

Head red, with clypeus and spot before the neck (often covered by thorax) infuscate; punctures rather large and sometimes ocellate, surface very minutely strigose; thorax rather evenly punctate, but punctures largest at the sides; behind the neck and in front of the scutellum are two large round black spots; elytra punctate-striate, interstices irregularly and finely punctate. Beneath, the prosternum is rugose and punctate, black between the coxæ, raised in the middle and slightly acute in front, lines incurved anteriorly or bent, being difficult to see owing to the rugosity of the surface; mesosternum with a variolous sculpture; abdomen, segments very minutely sculptured throughout, with fair-sized punctures interspersed, and in the three median segments the punctures are arranged in transverse bands.

Abundant at Hitoyoshi, May 3, 1881. Taken also at Nikko and Miyanoshita not uncommonly.

Triplax ainonia.

Oblongo-ovata, subopaca, dense punctata; thorace flavo, antice et postice in medio infuscato; antennis (clava excepta) pedibusque flavis. L. 3–$3\frac{1}{2}$ mill.

Above a little opaque and densely punctate; head and elytra obscurely, not intensely, black; the thorax is yellow, with a transverse antescutellar spot fuscous, and a similarly coloured maculation behind the head, which is characteristic because posteriorly much narrowed in the middle; the scutellum is blackish with seven or eight punctures; the elytra are punctate-striate, and all the interstices distinctly punctate, the punctures composing the striæ not varying much in size from those of the interstices. Beneath, the prosternal process is a little raised, but the striæ do not go much beyond the coxæ and terminate gradually. On the pro- and mesosternum the punctuation is rather large; the metasternum is minutely strigose (when seen under a high power) and sparsely punctate; the abdominal segments are also densely punctate.

The coloration is very similar indeed to that of the last species, but it is readily known by the punctuation.

I took some specimens from a fungus growing out of the lintel of an Aino hut near Shiraoi, and I have other examples from Sapporo and various places in South Yezo, and I think it is common in that district; but my visit to this Japanese Ultima Thule was of short duration.

Triplax sufflava.

Oblonga, pallide testacea; antennis pedibusque subinfuscatis. L. $4\frac{1}{2}$ mill.

Pale yellow, head sparsely but coarsely punctured; thorax with coarse punctures at the base on each side, with fine ones in front of the scutellum. The punctures forming the elytral striæ are also large, interstices less coarsely punctate, punctures placed in irregular rows, the apical disk of the elytra is suffused with a brownish colour; the scutellum is smooth. The last nine joints of the antenna are brownish, and the apical joint of the palpus is so transverse that its breadth equals the length of the first eight joints of the antenna. The prosternum has no proper lateral lines or striæ, but the coxæ are marginate.

Three examples, taken variously at Nikko, Chiuzenji, and on the road to Shingu in Yamato.

Triplax lætabilis.

Oblonga, nigra, nitida; elytris punctato-striatis, interstitiis tenuiter punctatis; antennis pedibusque in totum testaceis. L. $3\frac{1}{2}$ mill.

Black and very shining; elytra punctate-striate, interstices faintly punctured; legs, palpi, and antennæ testaceous, the latter somewhat abbreviated and robust, six to eight joints being slightly transverse. Beneath, the prosternum is almost impunctate, the prosternal process is raised, widest at base and terminating anteriorly acutely, the lateral lines meet in front at the edge of the prosternum. The mesosternum is transverse, almost impunctate, the metasternum is angulate on each side near the coxæ and sparsely puncticulate. The abdominal segments are microscopically strigose and obscurely red, except the basal ones, which are dark at the sides.

I obtained one example by a fortuitous stroke of the sweeping-net near the Ikenchaiya in Yamato, June 22, 1881.

Triplax canalicollis.

Oblongo-ovata, nigra, nitida, punctata; thorace lateraliter canaliculato; capite, antennis pedibusque rufis. L. $3\frac{1}{2}$ mill.

Black, shining; head, legs, palpi, antennæ (which are very small) and four apical segments of abdomen red; the thorax

is fairly punctured, with sides distinctly canaliculate. The punctures are large on the prosternum and the surface rather rugose; the lateral striæ do not pass anteriorly beyond the coxæ, where they are a little incurved at right angles. The abdomen is microscopically strigose, with some scattered punctures.

Four specimens, from Hakodate, Hitoyoshi, and Kashiwagi, localities showing a wide distribution for the species.

Triplax discicollis.

Elongato-oblonga, nigra, nitida; thorace flavo, disco infuscato pedibusque flavis; antennis basi rufis. L. 5 mill.

Head and thorax sparsely but rather coarsely punctured, the first black, the second yellow with disk largely and somewhat irregularly infuscate (in one specimen the dark disk is longitudinal only); scutellum impunctate; elytra finely punctate-striate, interstices irregularly and somewhat indistinctly puncticulate; legs pale; antennæ, first three or four joints reddish, the rest infuscate. The prosternum has scattered and rather coarse punctures, the prosternal lines terminating immediately before the coxæ.

In general coloration this species is similar to *T. amœna*, Solsky, with the exception of the elytra and abdomen, which are black. In *T. amœna* the elytra are subcyaneous and the abdomen red, and the outline is somewhat broadly ovate.

I obtained only five examples at Miyanoshita and Kashiwagi.

Triplax japonica.

Triplax japonica, Crotch, Ent. Mon. Mag. ix. 1873, p. 189.

"Oblonga, læte ferruginea, antennis (basi excepta), pectore elytrisque nigris."

Additional localities for this species are Junsai, Hakodate, Sendai, Miyanoshita, Kiga, and Hitoyoshi. "It resembles *rufipes*."

Triplax atricapilla.

Oblonga, subparallela, læte rufa; capite, antennis, pedibus elytrisque dimidio apicali nigris. L. $6\frac{1}{4}$ mill.

This fine species is almost the same in colour and structure as *T. apicata*, Crotch, from Assam. The only differences I see are that the head is wholly black and the prosternal lines more parallel in *T. atricapilla*.

I found one at Nara, June 30, 1881, and afterwards received four specimens from Higo. All are exactly alike.

Eudæmonius.

Antennæ fine and slender, the length of the thorax, first joint relatively stout and short, second short and much constricted before the middle, third somewhat small at the base and not so long as fourth and fifth together, fourth to eighth moniliform, sixth to eighth smaller than two preceding, ninth to eleventh equal in length, feebly (they are almost moniliform) dilated and not closely pressed; last joint of maxillary palpus very transverse; head with eyes prominent, not coarsely granulate; thorax broader than long, the middle of the base encroaching on the region of the scutellum; elytra subparallel, rather convex, with eight striæ; a sutural stria; legs rather short, tarsal joints one to three equal in length and breadth. Prosternum striate between the coxæ, striæ touching the base; mesosternum moderately large.

♂. Epistoma tuberculate anteriorly; tibiæ robust, anterior pair strongly rugose on the inner surface; tarsi moderately dilated.

♀. Epistoma subconvex; head smaller than in male, with the eyes more prominent; the legs and tarsi also are more slender. This sex is much smaller than the male.

The genus is allied to *Amblyopus*.

Eudæmonius tuberculifrons.

Oblongo-ovatus, parum convexus; capite nigro; thorace flavo, ante scutellum punctisque quatuor disci nigris; elytris punctato-striatis, pedibusque nigris. L. 5–8 mill.

Oblong-ovate, rather convex; head, antennæ (except second joint, which is pitchy red), elytra, legs, meso- and metasterna, and base of prosternum narrowly black; thorax flavous, with four black spots in a transverse line and a large black spot before the scutellum; head and thorax somewhat closely punctured, the latter with marginal striæ on all sides fine; elytra punctate-striate, with an additional sutural stria which does not touch the base; the interstitial punctuation is fine and scattered. The prosternum is somewhat raised in the centre, with two short coxal striæ; the mesosternum is proportioned much as in *Amblyopus*, to which genus *Eudæmonius* is apparently allied. The sexual characters as given above are very remarkable and conspicuous.

I took it at Miyanoshita and at Chiuzenji, abundantly in fungi on old cherry-trees, in May and June, and in August a few specimens at Sapporo, in Yezo.

Aulacochilus Bedeli, Harold.

Aulacochilus Bedeli, Harold, MT. Münchn. ent. Ver. iv. p. 170.

This species was first taken by Hilgendorf at Nikko; I obtained it in Higo early in June, and at the end of the month not uncommonly at Nara and Bukenji.

Aulacochilus japonicus, Crotch.

Aulacochilus japonicus, Crotch, Ent. Mon. Mag. 1873, p. 189.

On my second visit to Japan I found this insect, as above stated (p. 54), in Kioto, June 17, 1881, and other examples at Yokohama and Mayebashi.

In both the Japanese species of this genus, the prosternal striæ terminate before the coxæ, and the mesosternum is very widely marginate anteriorly.

SATELIA.

Antennæ as long as the thorax, first joint rather large, second smaller and round, third slightly longer than fourth and fifth together, third to eighth of nearly the same thickness, ninth to eleventh forming an oblong-ovate club; last joint of maxillary palpus robust and not angular; head moderate; eyes not prominent; scutellum cordate; prosternal process as in *Aulacochilus violaceus* (fig. 2, Ent. Mon. Mag. xxiv. p. 3, 1887); the mesosternum has a crenulate arched line beginning at the base and anteriorly crossing the centre. The general facies of this genus is that of a small *Dacne*, but the tarsi and prosternum are similar to those of *Aulacochilus*.

Satelia scitula.

Oblongo-ovata, subæneo-nigra, nitida, capite obscure rufo; elytris anticis oblique, apice transversim flavo-maculatis; antennis obscure rufis, pedibus rufo-testaceis. L. $2\frac{1}{2}$–$2\frac{3}{4}$ mill.

Head and thorax evenly and rather finely punctured, the first usually red, sometimes piceous, second black or obscure æneous black with distinct lateral margins; the elytra are punctate-striate with the interstices vaguely puncticulate, the anterior yellow fascia begins before the middle of the elytron between the first and second stria and after the fourth stria passes up to the humeral angle, the posterior band is transverse, leaving the suture and apex black; the arched crenulate stria of the mesosternum is a very striking character; the prosternum in front of the anterior coxæ has large subocellate punctures, within the prosternal lines the sculpture is rather rugose.

I took about a dozen examples in Higo and a few in Yamato. The species is a little variable in regard to the size of the fasciæ.

BIBLIOGRAPHICAL NOTICE.

The Agricultural Pests of India, and of Eastern and Southern Asia, Vegetable and Animal, injurious to Man and his Products. By Surgeon-General Edward Balfour. Sm. 8vo. London: B. Quaritch, 1887.

When a book is published with a benevolent object in view it becomes a most ungrateful task to find fault with it; and this unfortunately is what we have to do in the case of the little volume whose title stands at the head of this notice. Some knowledge of natural history, and especially of entomology, would seem to be necessary for the production of such a book; but this qualification apparently is not possessed by the author, or he could not have committed such a series of blunders as he is here guilty of. Thus, in a list of enemies of the coffee-plant taken from Nietner, he has substituted Coleoptera for Hemiptera and included under the former head three Coccidæ, an *Aphis*, and a Bug, together with a Fungus (but as regards the last Nietner must bear a part of the blame), and then converted Nietner's Coleoptera into Orthoptera: *Ancylonycha* is said to belong to the Orthoptera, although it produces the "White Grub" of the coffee-planters; and *Heliothis armigera* is referred to repeatedly as Orthopterous, and definitely said to be "one of the Gryllidæ," although it is immediately afterwards said to have "caterpillars" belonging to it, which "pass into the pupa and perfect form" within the capsules of the poppy, the perfect form being a "moth."

These are small matters; but a better idea of the peculiar fitness of the author for his undertaking may be formed from the following account of animal parasites:—"Animal parasites," we are told, "attack man and other animals. Among them may be named *Acari*, sp., the Argas, Ascarides, *Ancylostomum*, *Bothriocephalus*, *Cysticerci*, *Echinococci*, *Filaria*, *Fistularia*, flea, flukes, harvest-bug, Helmintha, louse, *Œstridea*, *Oxyurus*, *Sarcoptus*, *Spiroptera*, *Strongylus*, *Tœnia*, *Thecosoma*, tick, *Tricocephalus*. *The bites of all are painful, many of them dangerous.*" (The italics are ours; fancy the bite of an *Echinococcus* or *Cysticercus*!) And then we are told that "there are at least other six orders of noxious animals which, though so called, are not parasites, but which have a special interest to stock-owners and veterinary practitioners, viz. Nematoda, Trematoda, Cestoda, Acanthocephala, Diptera, and Trachearia."

Mr. Balfour mentions two entomologists of note who assisted him in the preparation of his book, and one of whom, he says, "revised nearly the whole in manuscript and the proofs as they passed through the press;" we can only say that the latter gentleman must have contented himself with a very perfunctory execution of the task he undertook.

We should hardly have devoted so much space to the consideration of such a work as this but for the fact that the author has undoubtedly hit upon a serious want, and we cordially agree with Miss Ormerod in the sentiments she expresses in a letter to the author which he prints in his "Prefatory Remarks." In fact no one can

doubt the immense importance of obtaining a clear and definite knowledge of those enemies of the agriculturist whose ravages are so often fatal to his hopes, and by calling attention to the want of any satisfactory body of information upon the injurious organisms of our Indian possessions the author certainly merits the thanks of all who have an interest in such matters. In the few opening pages of his work he has referred to several exceedingly interesting points and given some valuable advice; but in attempting to carry out his scheme in detail he has, we think, entirely mistaken the course to be pursued. The body of the work consists of a series of articles, many of them very short, arranged in alphabetical order, and as the subjects treated of are generally indicated by their scientific names, the book is evidently not well adapted for readers unacquainted with natural history. To a certain extent this difficulty is got over by means of a rather copious index; but this does not seem to be quite complete, and a much more judicious course with regard to the native names of the pests described would have been to insert them in their places with cross-references to the articles in which the species are noticed. Further, we are told in many articles that the creatures referred to belong to this or that class or order, but without any indications of the characters by which such groups are distinguished, although, in the great majority of cases, a rough notion of these distinctions might be intelligibly given in very few words.

In fact the broad defects of the book might easily be remedied without adding seriously, if at all, to its bulk, if only certain perfectly unnecessary articles were omitted. What possible ground there can be for introducing into a treatise on "Agricultural Pests" a notice on "Actiniæ and Medusæ" (chiefly dealing with *Physalia*) one is at a loss to understand; crocodiles also seem rather out of place; and the article on Fish, relating chiefly to such species as are poisonous when eaten, or furnished with spines with which they can inflict wounds, seems equally supererogatory. *Cannabis sativa* is mentioned solely on account of the intoxicating properties of some of its products; the Tse-tse fly has certainly nothing to do with India; gnats or mosquitos are not *agricultural* pests; so also leeches and fleas. With regard to the latter insects our author quotes, apparently with approval, the statement of a writer that "he had found fleas in limestone caverns, where their only possible supply of food was the animal matter that may have remained in the fossils, of which the limestone was chiefly composed!" Many creatures are mentioned as pests because they attack men, such as bees and wasps, scorpions, centipedes, &c., but they can hardly be said to confine their attentions to agriculturists any more than the land-leeches and fleas above mentioned. A species of *Epeïra* is noticed on account of its gigantic webs, which may be inconvenient to travellers. In certain articles frost, heavy rain, continuous wet weather, and hot winds are mentioned as if they were pests, but no remedial or preventive measures are suggested.

But it is needless to multiply examples of faults of omission and commission. There is not a page of the book, except perhaps in the

introductory portion, that is not open to serious criticism, and it is much to be regretted that, having taken up so important a task, the author has not performed it more satisfactorily. He may, perhaps, urge that it is a first attempt; but while this would be an excuse for much imperfection of special knowledge, it will not justify the peculiar faults which it has been our unwelcome duty to point out.

MISCELLANEOUS.

On the Phylogeny of the Bopyrinæ.

By MM. A. Giard and J. Bonnier.

The Bopyrinæ are comparatively rare animals, and parasitic upon a restricted number of genera of Crustacea belonging to the groups Cirripedia, Ostracoda, Schizopoda, and Decapoda. Confining ourselves for the present to the species parasitic upon Decapoda and especially on the Decapoda of European seas, we may remark this first interesting fact, that every species of Decapod infested by Bopyrinæ is so generally by two or more different species, and that very often in the same locality and sometimes even on the same individual. Thus, we find on *Xantho floridus*, *Cepon pilula*, G. & B., and *Cancrion floridus*, G. & B.; on *Pilumnus hirtellus*, *Cepon elegans*, G. & B., and *Cancrion miser*, G. & B.; on *Portunus arcuatus*, *Cepon Portuni*, Kossm., and *Portunion salvatoris*, Kossm.; on *Pagurus Bernhardus*, *Phryxus Paguri*, Rathke, and *Pleurocrypta Hyndmanni*, Sp. B. & W.; on *Galathea squamifera*, *Pleurocrypta Galatheæ*, Hesse, and *Gyge Galatheæ*, Sp. B. & W.; on *Porcellana longicornis*, *Pleurocrypta Porcellanæ*, Hesse, and *Entoniscus Muelleri*, G. & B.; on *Callianassa subterranea*, *Ione thoracica*, Mont., and *Pseudione* sp., Kossm.; on the species of the genus *Hippolyte*, Bopyrinæ of the genera *Phryxus*, *Gyge*, *Bopyroides*, and *Bopyrina*, &c.

All these Bopyrinæ, even the Entoniscidæ, are in reality external parasites. Nevertheless, according to the position which they occupy upon their host, the Bopyrinæ of the Decapoda may be divided into three distinct ethological groups:—1, abdominal parasites; 2, branchial parasites; 3, visceral parasites. Now the different species infesting the same Decapod generally belong to different ethological groups. If we seek for analogous examples in other families we may cite the Branchiobdellæ, three species of which infest *Astacus fluviatilis*, each in a particular region of the body; and three species, parallel to our European types, have likewise been indicated in the Japanese crayfish. Another example is furnished by the Diptera of the family Œstridæ, several species of which, some cuticolar, others cavicolar or gastricolar, infest at the same time certain types of Cervidæ or Equidæ. Facts of this kind, absolutely incomprehensible under the old hypothesis of the fixity of species, become exceedingly instructive if we accept the theory

of descent with modification. They indicate, in fact, that several states of symbiotic equilibrium have been successively established between the phylum of the parasites and that of their hosts. Still more, in the particular case of the Bopyrinæ, we can, by a careful study of the embryogeny, determine the order in which these various states of equilibrium have been produced, follow step by step the modifications caused in the organism by a parasitism gradually becoming more and more complete, and thus give a truly natural classification of these animals.

The first larva of the Bopyrinæ is very uniform throughout the group. By the long duration of its pelagic existence it teaches us that the ancestors of the Bopyrinæ were for a long time free forms. By its general organization it shows us that this ancestral form must have approached the Ægidæ, and more especially *Eurydice*. The differential peculiarities which these first larvæ present are furnished chiefly by the sixth pair of thoracic feet, and are in relation with the emergence of the embryo from the host which harboured the parent, and not, as has been supposed, with its entrance into a new host; from this it results that the modifications are numerous, especially in the group in which the parasitism is most decided, that is to say the Entoniscidæ.

The second free larval form has been called by us the *Cryptoniscian embryo* or *Cryptoniscus-stage*, because the males of the Cryptoniscidæ represent in a more complete fashion this transitory phase in the development of the other Bopyrinæ. It is under this form that the fixation of the Bopyrian upon its host is effected at the commencement of its parasitic life. In several Entoniscians (*Portunion Mœnadis* and *P. Kossmanni*), and in *Phryxus Paguri*, we have ascertained the presence of several Cryptoniscian embryos, attached to adult females provided with males. In some of them we have even observed spermatozoids apparently mature and normal. We may inquire whether, when the place upon the host is thus preoccupied, the Cryptoniscian larvæ do not, at least temporarily, play the part of complemental males. The attached larva speedily undergoes a series of transformations which, in the female Cryptoniscidæ, are accomplished in very different fashion from that which occurs in the other Bopyrinæ.

Further, while in the Cryptoniscidæ the male stops in its development at the second larval form, in the other Bopyrinæ it continues its evolution, and acquires a more or less Idotheiform aspect. We notice also that there exists an astonishing superposition of parasites and a triple parallelism between the genera *Cryptoniscus*, *Zeuxo*, and *Danalia* of the family Cryptoniscidæ, and the genera *Peltogaster*, *Lernæodiscus*, and *Sacculina* of the group Rhizocephala, and the genera *Pagurus*, *Porcellana*, and *Cancer* of the infested Decapoda.

Lastly, the singular coexistence of parasitic Cirripedes in all the types of Decapoda infested by Bopyrinæ, and the existence of forms such as *Phryxus resupinatus*, which, although no longer belonging to the group Cryptoniscidæ are still nevertheless indirect parasites of the Decapoda, lead us to the hypothesis that the Bopyrinæ were

introduced among the Decapoda by the Rhizocephalan Cirripedes. While one branch of the Cryptoniscidæ has remained faithful to its first hosts, another has become adapted to direct parasitism upon the Decapods, and has given origin to the group of *Phryxus*, *Bopyrus*, and the Entoniscidæ.

Thus, by a fact of ethological atavism, would be explained the simultaneous presence, so often ascertained, in the same Decapod, of a Rhizocephalan and a Bopyrian parasite (*Sacculina Carcini* and *Portunion Mœnadis*, *Entoniscus Porcellanæ* and *Lernæodiscus Porcellanæ*, &c.).

The existence of a Phryxoid stage in the evolution of the females of most Bopyrinæ shows that the genus *Phryxus* may be regarded as the stock from which there have issued, on the one hand, the Ioninæ, which are in a manner an exaggeration of it; and, on the other, the asymmetrical branchial Bopyrinæ. This Phryxoid stage is observed in *Pleurocrypta*, *Bopyrus*, *Cepon*, *Ione*, &c. It has caused many errors on the part of the zoologists who first studied these animals. The *Phryxus*-stage of *Cepon typus* was taken by Duvernoy for the male of that Bopyrian. *Phryxus fusticaudatus*, Sp. B. & W., is the *Phryxus*-stage of *Pleurocrypta Hyndmanni*, Sp. B. & W.*; *Phryxus longibranchiatus*, Sp. B. & W., corresponds in part to the *Phryxus*-stage of *Pleurocrypta Galatheæ*, Hesse (*non* Sp. B. & W.†). In the Entoniscidæ the *Phryxus*-stage appears less distinctly, and it is possible that this group may have diverged from the stock at a very ancient period, which would be in accordance with its more decided parasitism.—*Comptes Rendus*, May 9, 1887, p. 1309.

On Parasitic Castration in Eupagurus Bernhardus, *Linné, and in* Gebia stellata, *Montagu*. By M. A. Giard.

In a recent memoir‡ I made known the curious morphological effects produced in several Decapod Crustacea by the castration produced by the presence of Rhizocephalan or Bopyrid parasites. Further and very remarkable examples of these phenomena are presented by the hermit-crabs infested by *Phryxus Paguri*, Rathke, and by the *Gebiæ* infested by *Gyge branchialis*, Corn. & Panc. Although *Phryxus Paguri* is an absolutely external parasite, the modifications which it occasions are as extensive as those observed in certain Brachyura in consequence of their infestation by Rhizocephalans.

It is well known what are the external sexual characters of the *Eupaguri*. In the female the genital aperture is situated upon the basal joint of the third pair of thoracic feet; in the male this orifice is placed upon the base of the fifth pair of feet, which bears

* We have met with this Bopyrian of the branchial cavity of *Pagurus Bernhardus* at Roscoff, and at Equihen, near Boulogne-sur-Mer.

† We have studied this parasite of *Galathea squamifera* at Roscoff and at Fécamp.

‡ Bull. Sci. du Nord, tome xviii. (1887), pp. 1–28. Translated in 'Annals,' May 1887, pp. 325–345.

a small papilla; the large chela of the first pair of thoracic feet is rather stronger in the male than in the female. As regards the abdomen, the first segment is destitute of limbs in both sexes. In the female segments 2, 3, 4, and 5 bear, on the left side, appendages formed of a basal joint terminated by two branches. On the second segment the outer branch is shorter than the inner one; on the third, the two branches are nearly of the same length; on the fourth, the outer branch is a little longer, and on the fifth segment it is much longer than the inner one. The appendages 2, 3, 4 are constructed to retain the eggs. For this purpose their basal joints bear two tufts of hairs; the inner branch also presents two tufts of hairs, one at its extremity, the other on a highly developed posterior swelling.

In the male segment 2 is destitute of appendages, segments 3, 4, and 5 bear on the left side biramose feet, of which the inner branch, which is always without a posterior enlargement, is much smaller than the outer one. The appendages of the fifth segment are very similar in the two sexes.

The male hermit-crabs infested by *Phryxus Paguri* are scarcely altered in the thoracic region, except that the large chela may be a little smaller than usual. *But the abdomen presents appendages in equal number to those of the female, and constructed absolutely as in the female, although of rather smaller dimensions.*

On opening one of these males with female abdominal feet we find the testis containing spermatophores of much less than the normal size (about one half), and very imperfect spermatozoids.

I expected to meet with the same phenomena, perhaps even more accentuated, in male hermit-crabs infested by *Peltogaster Paguri*; but, astonishing to say, there is nothing of the kind; and notwithstanding the more profound action which we should be inclined, *à priori*, to ascribe to the *Peltogaster*, that Rhizocephalan produces no apparent modification of the external characters of the male sex, although it causes the sterility of its host.

The female hermit-crabs infested by *Peltogaster*, on the other hand, are frequently modified, and the modifications of course affect the abdominal feet. The tufts of hairs on the basal joint and the posterior ovigerous projection of the branch disappear more or less completely; further, the inner branch is generally smaller than the outer one, even in the appendages 2 and 3; in one word, the abdominal feet of these castrated females clearly approach those of the male sex.

From what precedes we are led to conclude either that certain *Peltogasters* attach themselves to the hermit-crabs at a later period than the *Phryxi* or that the *Peltogasters* exert a slower action than the *Phryxi*, and do not prevent the sexual differentiation from being produced, at least in the male sex. The former interpretation, in our opinion, is the more probable.

Further, the facts just noted seem to indicate that the *Phryxi* in general attach themselves to the hermit-crabs at an age when the sexual differentiation has not been effected, and while the Decapod crustacean still presents the embryonic abdominal feet. Now Fritz

Müller has made known a *Phryxus* of the Brazilian coast (*Phryxus resupinatus*) which constantly attaches itself to hermit-crabs infested by *Peltogaster purpureus*, and often upon the very peduncle of that Rhizocephalan. If we accept the hypothesis of the inoculation of the larvæ of Rhizocephala put forward by M. Y. Delage, it would therefore be necessary to suppose that the larva of *Phryxus resupinatus* divines which are the hermit-crabs inoculated with an embryo *Peltogaster*, and the precise place at which this embryo will emerge from the abdomen of the hermit-crab. We can escape from this curious conclusion only by assuming, upon a still more curious hypothesis, that the embryos of *Phryxus* themselves are also inoculated and follow the larvæ of *Peltogaster* in their internal migration. Who would accept such a complication? On the other hand, all becomes simple on the theory of direct fixation, and we may find in the new facts above described a confirmation of the opinion expressed by us, that in the phylogenetic series the Cirripedes have been the introducers of the Bopyridæ among the Decapod crustaceans. The Isopods, originally parasitic upon the Rhizocephala, have infested the higher crustacean, at first indirectly, but afterwards directly.

I have endeavoured to extend the observations relating to parasitic castration to other Decapods, but unfortunately the materials for such an investigation are difficult to get together. Notwithstanding my great desire to do so, I have as yet been unable to examine male *Callianassæ* infested either by *Parthenopea subterranea* or by *Ione thoracica*. Although *Gebia stellata*, Montagu, is abundant at various parts of the coast of France (especially at Concarneau), I have never found on our shores the parasitic Bopyrid of that species, *Gyge branchialis*, Cornalia and Panceri. I possess a single example of an infested *Gebia*, which came from the Laboratory at Naples. This specimen, however, is a male, and I have been able to ascertain that it presents the first pair of simple abdominal feet which normally exists only in the female; the chela of the first pair of thoracic feet has remained stronger than in the females. Nardo, who observed in a locality where *Gyge branchialis* is abundant, says that he has sometimes found the first abdominal appendage in both sexes:—"Io posso assicurare però che di tali appendici poste una per lato sotto il primo anello dell' Addome, va pure fornita la femmina, *ed essere anche vero che talvolta ne sono entrambi sprovvedati*" *. It is probable that these abnormal males were or had been infested by *Gyge*.

The Brachyura infested by the Bopyridæ of the genus *Cepon* (*Pilumnus hirtellus* and *Xantho floridus*) and examples of *Porcellana longicornis* infested by *Pleurocryptus Porcellanæ* have presented no appreciable modification of the external sexual characters.—*Comptes Rendus*, April 18, 1887, p. 1113.

* Nardo, 'Annotazioni illustranti 54 specie di Crostacei,' Venice, 1869, p. 100.

CONTENTS OF NUMBER 115.—*Fifth Series.*

Page

I. The Significance of the Yolk in the Eggs of Osseous Fishes. By Edward E. Prince, St. Andrews Marine Laboratory. (Plate II.) 1

II. Notes on Coleoptera, with Descriptions of new Genera and Species.—Part VI. By Francis P. Pascoe, F.L.S. &c. (Plate I.) . 8

III. Catalogue of Ceylon Algæ in the Herbarium of the British Museum. By George Murray, F.L.S., Assistant, British Museum, and Examiner in Botany, Glasgow University 21

IV. Contribution to the Knowledge of the Land-Planariæ. By Dr. D. Bergendal 44

V. Descriptions of new Reptiles and Batrachians in the British Museum (Natural History).—Part III. By G. A. Boulenger 50

VI. A List of fifty *Erotylidæ* from Japan, including thirty-five new Species and four new Genera. By George Lewis, F.L.S..... 53

BIBLIOGRAPHICAL NOTICE.

The Agricultural Pests of India, and of Eastern and Southern Asia, Vegetable and Animal, injurious to Man and his Products. By Surgeon-General Edward Balfour 74

MISCELLANEOUS.

On the Phylogeny of the Bopyrinæ. By MM. A. Giard and J. Bonnier 76

On Parasitic Castration in *Eupagurus Bernhardus*, Linné, and in *Gebia stellata*, Montagu. By M. A. Giard 78

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THE ANNALS

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[FIFTH SERIES.]

No. 116. AUGUST 1887.

VII.—*Bryozoa from New South Wales, North Australia, &c.*

By Arthur Wm. Waters.

[Plate IV.]

Part I.

The collection now described was kindly sent to me by Mr. Brazier, of Sydney, who had dredged the specimens himself and carefully noted the localities and depths, thus greatly increasing its value. The New South Wales collection was recently received; but to this I have added some dredged near New Guinea, which Mr. Brazier gave me a few years ago, and I have also mentioned a few New South Wales specimens sent to me by friends.

My work has for a long time been mostly with fossil* Bryozoa from Australia and New Zealand, and it has been necessary to make constant comparisons with recent ones, so that, although publishing in geological periodicals, I have added many new localities for recent forms, and also pointed out many cases of fossil species still being found living; and it is to be hoped that those communications may be useful to

* Quart. Journ. Geol. Soc. vol. xxxvii. p. 309, vol. xxxviii. pp. 257 and 502, vol. xxxix. p. 423, vol. xl. p. 674, vol. xli. p. 279, vol. xliii. p. 40.

students interested in geographical distribution, a point with which I again deal fully.

Another point to which I was obliged to devote special attention was the indications given by palæontology as to the relative value of various characters, and this again could not be done by questioning fossils alone; but recent forms were also examined. This has naturally made me a warm supporter of those who saw that the mode of growth and zoarial characters generally must, in importance, be placed after the zoœcial. Of the zoœcial characters the shape of the oral aperture is the most useful, and this, I have pointed out *, can best be studied by means of the opercula; and both Busk and MacGillivray, and myself have shown that the avicularian mandibles furnish characters of the greatest value specifically. My own collection of these chitinous elements represents many hundred species, and their importance can scarcely be overrated, for in many cases there are minute characters which are distinctly of specific value, but unless the opercula or mandibles are carefully separated out some of the most important points will not be noticed. It was quite incomprehensible how Mr. Busk had overlooked so many details in his 'Challenger' work, until I saw some collections illustrating these chitinous elements, which he presented to the British Museum, and then it became quite clear that mounting them in mass, surrounded by the integumentary tissues, accounted for his not having seen many things of importance.

It is of course very tedious teasing out these covers under the microscope; but for fresh descriptions or doubtful cases it should, if possible, be done; also calcined preparations of a portion of the zoarium should be made to show the calcareous structure, and decalcified pieces should also be mounted. This can best be done in glycerine jelly, the air being removed after decalcification by prolonged soaking in spirit, and then the specimen must be transferred to a mixture of glycerine and spirit, and thus gradually into pure glycerine. Such genera as *Catenicella* should be thus studied.

There are only five species of *Catenicella* in these collections, and they have been a good deal knocked about by the waves. The opercula of this genus have so far not received any attention, nor in this family are they likely to be of so much use as in many others, since there are many species with scarcely distinguishable covers. There appear, how-

* "The Use of the Opercula in the Determination of the Chilostomatous Bryozoa," Proc. Manchester Lit. & Phil. Soc. vol. xviii. p. 8; "On the Use of the Avicularian Mandible," &c., Journ. Microscopical Soc. ser. 2, vol. v. p. 774.

ever, to be three types, namely:—those nearly round, as *C. Buskii* (*fusca* and *sacculata*), *C. pusilla*, *C. delicatula*, *C. cornuta*, *C. elegans*, *C. perforata*, *C. formosa*, *C. crystallina*, *C. Hannafordii*, *C. insignis*, *C. umbonata*, *C. taurina*; this includes the *vittatæ* of Busk, many having the ovicells central, but this is not universal, *C. cornuta*, *C. perforata*, and *C. taurina* having them terminal or geminate. The second type, including *C. amphora*, *C. ventricosa*, *C. intermedia*, *C. lorica*, *C. hastata*, *C. alata*, *C. carinata*, *C. Wilsoni*, *C. pulchella*, *C. urnula*, and *C. margaritacea*, has the operculum straight below or concave, and corresponds nearly with Mr. Busk's fenestrate group, having the ovicells usually terminal; but this is not the case in *C. carinata*. The next type has a triangular operculum, and perhaps should again be divided into (*a*) the small species, *C. aurita*, *C. geminata* (see fig. 22), and fossil *C. lævigata*, Waters, and *C. longicollis*, W., with a sinus in the aperture, for which MacGillivray has proposed the genus *Claviporella*; this leaves (*b*) the large ones, *C. ponderosa*, *C. ornata* (see fig. 21), *C. solida*, W., and perhaps these should be called *Calpidium*.

It has seemed to me that the terminology in general use was not sufficient for describing the *Catenicellæ*, and therefore when dealing with the fossils, where we have only individual beads or internodes to examine, I suggested ("Chilost. Bry. from Muddy Creek &c.," Quart. Journ. Geol. Soc. vol. xxxix. p. 428) that we should call each bead a "globulus," again distinguishing those with two zoœcia as "biglobuli." In *C. ornata* there are more than two zoœcia, and this is also the case in an interesting fossil from Curdie's Creek, where the internode or multiglobulus has several zoœcia arranged in a bicellate series (Quart. Journ. Geol. Soc. vol. xxxvii. p. 318, pl. xvi. figs. 78, 79).

I also (Quart. Journ. Geol. Soc. vol. xxxix. p. 428) suggested that in the fenestrate division we should distinguish the compartments surrounding the zoœcium as "supra-avicularian," "avicularian," "infra-avicularian," and "pedal." These are most typically represented in *C. alata*; whereas in the first type (namely those with rounded apertures) some of the compartments, even when distinguishable, are very rudimentary.

The mandibles, again, are not of much use, as they are very similar in most of the species examined. In all these there is a comparatively large part in the centre consisting of only one layer and nearly transparent; and as the position of this part varies in the mandibles of many of the Bryozoa and is

valuable for diagnostic purposes, I propose to designate it the "lucida."

There is another character which seems to have had no attention; that is the method of rooting or attachment. In some, as *C. cacatua*, *C. delicatula*, *C. alata*, *C. carinata*, *C. pusilla*, *C. pulchella*, an isolated chitinous tube starts from the back of some of the globuli, and is attached by a spreading grapnel to any substance near; in others, as *C. crystallina*, *C. formosa*, *C. cribraria*, *C. taurina*, *C. cornuta*, *C. perforata*, *C. Hannafordi*, *C. elegans*, *C. insignis*, *C. ventricosa*, *C. hastata*?, *C. lorica*, tubes arise on either the dorsal or front surface, sometimes on both, and several such radicles may start from the same zoœcium. These unite and form solid bundles, becoming thicker towards the base. So far as my collection enables me to judge these are from the dorsal surface in *C. Hannafordi*, *C. margaritacea*, *C. ventricosa*, *C. hastata*?, *C. lorica*, *C. formosa*, *C. cribraria*, *C. cornuta*, *C. perforata*, and from the front in *C. elegans*; in *C. umbonata* mostly from the front, but also from the dorsal surface; in *C. delicatula*, *C. insignis*, *C. taurina* from the back or front. How far these growths are influenced by local conditions can only be examined by those on the spot.

Rooting and articulation seem to be correlated growths—that is, chitinous tubes may be given off to attach the colony to foreign substances or to attach one internode or one part to another, thus allowing motion without destroying the connexion between various sections of the colony. In the same way the radicle-growths of *Idmonea interjuncta* are very similar to the cross bars forming the network, whereas in *I. Milneana* both are stouter; and this will be referred to when dealing with the Cyclostomata.

I was surprised to find that no description of these radicles is given in a large number of species where they occur, and also came upon some interesting cases of articulation which had been overlooked, for instance, in *Caberea lata*, from Holborn Island; I have a specimen in which where the branches divide there are two chitinous tubes, which join in a quasi-ganglionic knot, from which a tube is given off to each branch (see fig. 4).

In thinking this all over it seemed somewhat curious that such a form as *Membranipora roborata* should show no indications of articulation, and in consequence I reexamined my mounted specimens to see how far this was the case, and was not surprised to find that in the unilaminate form where a dichotomization had taken place, and where the zoarium is

readily broken, there were in the interior several chitinous tubes passing from the upper to the lower zoœcia.

There is rooting without articulation in typical *Bugula* and *Flustra*, but these genera have both very little calcareous matter; on the other hand, we see articulation in *Bicellaria*, which is considered sufficiently allied to *Bugula* to be placed in the same family.

In *Catenicella* and other genera a raised disk is formed, out of which the radicle-tube grows, and the connexion with the interior seems to be by means of a rosette-plate at the base of the disk. *Diachoris* has similar roots, and the question may arise as to how far the connecting tubes are to be compared with articulation. I have considered them analogous with the tubes in which the rosette-plates occur in incrusting and erect species; and this view I think is the most probable. *Membranipora radicifera* is rooted with distinct chitinous tubes, on which account MacGillivray has gone so far as to propose its being placed with *Beania*; but this, I think, will scarcely be accepted. What I called *Diachoris patellaria*, Moll, is attached by means of a row of integumentary tubes; nevertheless MacGillivray places it under *Amphiblestrum*. Probably both these cases are only modifications of the mode of attachment which obtains in many incrusting forms, to which I shall have to refer later on.

This first paper happens to deal with articulated species; but this is a character which cannot be considered of primary importance, seeing that it includes a large number of purely Membraniporidan type; others of Microporidan, as *M. ratoniensis*; Microporellidan, as *Adeona* &c.; Poridan, as *Tubucellaria*; or Cellaridan, in a species which, as pointed out, is known unarticulated both living and from the Cretaceous formation. The classificatory value of articulation may, however, not always be the same, as there may be cases where articulation has taken place at a time far removed from the present, and from these parents further differentiation has obtained, forming various articulated groups; in other cases local circumstances may have recently caused articulation without any other character having changed. The mode of articulation seems to be of specific value, but within the same generic group is often very various.

1. *Eucratea chelata* (L.).

Cosmopolitan. Off Shark Island, 8 fath.

2. *Catenicella alata*, W. Thomson. (Pl. IV. fig. 9.)

Catenicella alata, W. Thoms., "On new Genera and Species of Polyzoa," Zool. Bot. Assoc. Dublin, 1859, vol. i. p. 80, pl. vi. fig. 4; MacGillivray, Zool. Vict. dec. iii. p. 21, pl. xxiv. fig. 7; Waters, Quart. Journ. Geol. Soc. vol. xxxvii. p. 317, pl. xvi. figs. 47, 49, 58, vol. xxxvii. p. 260, vol. xxxix. p. 428, pl. xii. figs. 15, 16.

The opercula are straight below, having a second layer in the upper part, which is often divided down the centre.

Miss Jelly submitted to me a closely allied *Catenicella* from Port Phillip, which, from the general characters and arrangements of the compartments, I at once pronounced to be a variety of *alata*; but every cell is geminate, with one fresh globulus growing from the centre of one of the zoœcia of the previous globulus, first from the right, then from the left, and so on. Between the two zoœcia in the centre of the globulus there is a small avicularium, and this is also the case in the geminate cells of typical *C. alata*, but is not a common character in the *Catenicellæ*.

I mention this variety at some length, as we have the same minute characters with two different modes of increase, and I consider that this gives support to the view expressed that the genus *Catenicellopsis* should be dropped. Since the above was written, MacGillivray has called this *C. gemella*, and therefore it should stand as *C. alata*, var. *gemella*.

Loc. Recent: Bass's Straits, Port Fairy (*Dawson*); Queenscliff; Tasmania; New Zealand; La Pérouse, New South Wales. Fossil: Mount Gambier; Muddy Creek; Bird Rock; and Waurn Ponds (*W.*).

3. *Catenicella ventricosa*, Busk. (Pl. IV. fig. 13.)

Catenicella ventricosa, Busk, Cat. Mar. Polyz. p. 7, pl. ii. figs. 1, 2, pl. iii. figs. 1-5; MacGillivray, Zool. Vict. dec. iii. p. 18, pl. xxiv. fig. 3; Waters, Quart. Journ. Geol. Soc. vol. xxxix. p. 431.

Specimens from La Pérouse have chitinous radicle-tubes from the front and dorsal surface, and these ultimately form very solid bundles. In one case, where there has evidently been an accident, tubes connect the neighbouring cells, thus saving the colony from injury.

Loc. Bass's Straits; Victoria; Tasmania; Port Fairy; New Zealand (*Hutton*); La Pérouse, Botany Bay. Fossil: Bird Rock (Victoria).

4. *Catenicella hastata*, B. (Pl. IV. fig. 10.)

Loc. Bass's Straits; Victoria; New Zealand; La Pérouse,

Botany Bay. Fossil: Bird Rock, and Waurn Ponds (Victoria).

5. *Catenicella Buskii*, W. Thoms. (Pl. IV. fig. 12.)

Catenicella Buskii, Thomson, "On new Genera and Species of Polyzoa," Zool. Bot. Assoc. Dublin, vol. i. 1859, p. 83, pl. viii. fig. 2; MacG. Zool. Vict. dec. iii. p. 24, pl. xxiv. fig. 12.
Catenicella fusca, MacG. *loc. cit.* dec. ix. p. 33, pl. xc. fig. 1.

This is closely allied to *C. gibbosa*, and should perhaps only be considered a variety. The relationship to *elegans* is evident, but how close is somewhat uncertain, as Busk says of *elegans* "ovicell geminate," whereas MacGillivray says ovicell like that of *Buskii*.

Operculum 0·02 millim. wide.

Loc. Western Australia; Bass's Straits; Queenscliff; La Pérouse, Botany Bay, washed on shore.

6. *Catenicella delicatula* (Wilson). (Pl. IV. fig. 11.)

Catenicellopsis delicatula, J. B. Wilson, "On a new Genus of Polyzoa," Micr. Soc. Victoria, vol. i. no. 2, p. 65, pl. iv. fig. 2; MacGillivray, Zool. Vict. dec. xi. p. 30, pl. cvii. fig. 2.

I cannot see that this should be separated from *Catenicella* merely on account of the branches sometimes originating from the sides of the cells. In a specimen from Queenscliff the increase is usually by means of geminate globuli; but there are many which spring out of the side of others and are attached by a chitinous tube. I have a specimen of *C. Hannafordi* in which a new branch starts from the front of a globulus in a similar way; and we also see the same mode of increase in *Menipea crystallina*, *Didymia simplex*, &c., and this should make us hesitate before adopting a new genus. And as supporting this and showing that *Catenicellopsis* should not be separated on account of its mode of growth, I may mention that in my specimens of *C. pusilla* the zoœcia do not spring laterally from the others.

In the small specimens from La Pérouse none of the globuli originate laterally from the others. There are numerous chitinous tubes starting either from the back or the front and united into bundles which become more massive near the base; besides these there are isolated ones springing from the dorsal surface and ending in grappling-hooks.

Operculum nearly round, with muscular attachments at each side, placed about one third of the distance between the proximal and distal edges.

Loc. Living: Spring Creek; Port Phillip Heads; Sor-

rento; Queenscliff; and La Pérouse, Botany Bay, washed on shore.

7. *Cellularia cuspidata*, Busk.

Cellularia cuspidata, Busk, Cat. Mar. Polyzoa, p. 19, pl. xxvii. figs. 1, 2; 'Challenger' Report, p. 17; MacGillivray, Zool. Vict. dec. vi. p. 31, pl. lviii. fig. 1; Haswell, Polyzoa from Queensland, p. 36.

On the dorsal surface there is often a single "perforation," and in a few cases two; but at the position of this perforation there is a muscular attachment for the operculum.

The new branches spring by means of a chitinous tubular connexion from the central cell, and the two side zoœcia are continuous, though rather modified in shape, being thin at the line of junction of the internodes, and with the movement of the new internode seem readily broken. The articulation of *C. Peachii* is by two chitinous tubes to each new branch, one from the central cell and one from each lateral one.

In *C. cuspidata* above the outer angle of the modified cell in each new branch a concave disk is formed, and from this a long chitinous radicle-tube is thrown out. In a few cases there is a radicle thrown out above the outer angle of other cells; but this is not usual. These tubes have not been mentioned by Busk or MacGillivray.

Loc. Australian and New-Zealand seas generally; Shark Island, New South Wales, 8 fathoms.

8. *Menipea crystallina*, Gray.

Loc. Bass's Straits; Queenscliff; Bondi Bay (New South Wales); Tasmania; Straits of Magellan; Campbell Island; New Zealand; La Pérouse, Botany Bay.

9. *Menipea cervicornis*, MacG., var.
(Pl. IV. fig. 1.)

Type *Menipea cervicornis*, MacG. Zool. Vict. dec. vi. p. 34, pl. lviii. fig. 4.

The specimens from Shark Island are without lateral avicularia, but have a small median one on the tricellate internodes at a bifurcation. The internodes are much more elongate than in the typical *M. cervicornis*.

10. *Scrupocellaria scrupea*, Busk.

A specimen from Shoalhaven beach has zoœcia similar in shape to those of the European seas, and the spines, fornix,

avicularia, and vibracula also agree; but, on the other hand, the internodes are short, with usually only three pairs of zoœcia.

11. *Canda arachnoides*, Lamx. (Pl. IV. fig. 7.)

Canda arachnoides, Busk, Brit. Mus. Cat. p. 26, pl. xxxiii.; 'Challenger' Rep. p. 25.

A specimen from La Pérouse has few avicularia, and in large pieces of *C. arachnoides* I have noticed that some parts will be found without avicularia, while in other parts they are abundant.

The increase at the dichotomization, which must often have been examined, does not seem to have been described. Between the two rows of zoœcia an additional one is formed, and from this two chitinous tubes are given off which are curved forwards to the inner zoœcium of a new branch. The other zoœcia are formed direct from the ordinary zoœcia. This seems to be the way in which growth takes place in most of this group, as already seen in *Cellularia cuspidata*, where in the same way the new branches spring by means of a chitinous connexion from the central cell, and the two side cells are continuous, though rather modified in shape; and here, as in some other cases, the articulation does not exist at first, or only partially so, and there is calcareous continuity until the movement of the water causes a fracture at the joint. I have pointed out (Quart. Journ. Geol. Soc. vol. xxxvii. p. 320) that the calcareous wall of *Cellaria* is at first continuous, but is in the same way fractured as growth progresses, some species retaining the continuity longer than others, so that perhaps this may be of specific value.

The oral aperture occurs in a round opening at the lower part of the apparent aperture, and on this account I think there is ground for separating *Canda* from *Caberea*, which has a distinct operculum * closing a rigid oral aperture. This never seems to have been fully figured, although of great importance, perhaps sufficient to separate it from the family Cellularidæ.

Loc. Bass's Straits; Timor; New Zealand (*B.*); Tasmania; Geelong; Port Phillip Heads; La Pérouse.

12. *Caberea Boryi* (Aud.).

Crisia Boryi, Aud. Voyage dans l'Egypte, pl. xii. fig. 4.

* "On the Use of the Avicularian Mandible," &c., Trans. Micros. Soc. ser. 2, vol. v. pl. xiv. fig. 15.

Caberea Boryi, Busk, Brit. Mus. Cat. p. 38, pl. xvi. figs. 4, 5; Hincks, Brit. Mar. Polyzoa, p. 61, pl. viii. figs. 9–11; Waters, "On the Use of the Avicularian Mandible," Journ. Micr. Soc. ser. 2, vol. v. p. 774, pl. xiv. figs. 9, 10, 15.

I am inclined to think that the calcareous border below the operculum should be considered of generic importance, and that this is the only known representative of the genus. This character, with the operculum placed diagonally, seems to have been often overlooked, but was correctly figured by Audouin (see his fig. 4). Mr. Hincks's figure looks as though it was the opening to the ovicell, and in his description no allusion is made to it.

Loc. British; Mediterranean; New Zealand; Bondi Bay and Adelaide. Fossil: Pliocene of Calabria (*Seguenza*).

13. *Caberea grandis*, Hincks.

Caberea grandis, Hincks, Ann. & Mag. Nat. Hist. ser. 5, vol. viii. p. 50, pl. iii. fig. 4; Waters, Quart. Journ. Geol. Soc. vol. xxxviii. p. 261.
Caberea rudis, Waters, ibid. vol. xxxvii. p. 322, pl. xviii. fig. 86.

Loc. Curtis Island; Port Phillip Heads; Darnley Island, Torres Straits, sievings from 10–30 fath. Fossil: Curdies Creek (S.W. Victoria); Bairnsdale; Mount Gambier.

14. *Caberea rostrata*, Busk.

Caberea rostrata, Busk, 'Challenger' Rep. p. 28, pl. xxxii. fig. 4.

There is a small piece from La Pérouse. A form like this with a large area, covered with an integument in which is an operculum of the Membraniporidan type, seems to differ considerably from *C. Boryi*, in which the entire chitinous operculum is surrounded by a calcareous border and is entirely above the fornix, and would seem more closely allied to *Scrupocellaria* than to *C. Boryi* and *C. Lyalli*, Busk. I have *C. Boryi* from Bondi Bay and Adelaide.

Loc. New Zealand; La Pérouse.

15. *Didymia simplex*, Busk. (Pl. IV. fig. 20.)

Didymia simplex, Busk, Voyage of the 'Rattlesnake,' p. 383, t. i. fig. 6; Cat. Mar. Polyz. p. 35, pl. xxxix.; 'Challenger' Report, p. 47; MacGillivray, Zool. Vict. dec. v. p. 34, pl. xlvi. fig. 6.

In a few cases fresh branches arise from the front of the zoarium, usually growing from the front of the pair of zoœcia below the pair where bifurcation takes place. This new branch consists at first of only one zoœcium, but the next globulus is bicellate. Chitinous radicle-tubes grow from the dorsal surface of the lower zoœcia.

Busk says ('Challenger' Report, p. 47) that he "could not find any rosette-plates between the zoœcia placed side by side;" but there are two elongate elliptical ones in the median line of the lateral wall near each end.

Loc. Bass's Straits; Queenscliff; Portland (Victoria); Station 163 A. Off Twofold Bay; Tasmania; Shark Island, 8 fath. (New South Wales).

16. *Dimetopia spicata*, Busk.

Loc. Bass's Straits; Queenscliff; Cape Otway; Portland; La Pérouse; New Zealand.

17. *Bugula neritina* (L.). (Pl. IV. figs. 3 and 15.)

For synonyms see Busk, Report of 'Challenger,' p. 42, and add *Acamarchis neritina*, Aud., Savigny's 'Egypte,' p. 69, pl. xi. fig. 1.

Bugula neritina has always been described as without avicularia; but a common form from Ball's Head, Port Jackson, has them in abundance situated at the base of the zoœcia. The beak of the avicularium is prominent and the mandible is large. The mandible is longer than that of *dentata*, but the beak is narrower, and, as in *B. dentata* and *B. avicularis*, there are two small muscular prominences on the proximal chitinous ridge. The shape of the mandibles of *B. dentata*, *B. flabellata*, *B. turbinata*, *B. avicularis*, and *B. plumosa* is almost identical, and they vary in size in the order given.

On the other hand *Bugula Murrayana* has a very long and narrow mandible with the lateral processes curved downwards, whereas the others have a straight lower edge. These "articular processes" are very marked in all the *Bugulæ*, and occur also in *Membranipora*, *Cribrilina*, and *Microporella*, showing that Mr. Busk attached too much importance to them when he to a large extent based the family Adeoneæ on this character.

Mr. Hincks informs me that specimens from Zanzibar and the Arabian Sea marked *B. neritina* have avicularia, and I was told in the British Museum that an Asiatic specimen also had avicularia; but I am not sure whether the observations have been confirmed. Specimens from Shark Island, 8 fath., have no avicularia.

18. *Bugula dentata* (Lamx.). (Pl. IV. fig. 14.)

Loc. Australia; New Zealand; Tasmania; South Africa; Ball's Head, Port Jackson, 12 fath.

19. *Cellaria gracilis* (Busk). (Pl. IV. fig. 6.)

Salicornaria gracilis, Busk, Brit. Mus. Cat. p. 17, pl. lxiii. fig. 3; 'Challenger' Report, p. 93.
Cellaria gracilis, MacGillivray, Zool. Vict. dec. v. p. 50, pl. xlix. fig. 4.

Some fragments from Raton are without avicularia, and then it is difficult to distinguish between *C. Johnsoni*, B., and *C. gracilis*, B.; but the large semicircular opening of the ovicell, often with a very distinct lip, agrees with specimens from Holborn Island, and, I think, enables it to be separated from *C. Johnsoni*, B., with certainty, as this last has smaller elliptical openings. There are Cretaceous fossils from Maestricht &c. which, in the zoœcial characters, are allied to *Cellaria*, although they were erect and unarticulated. The solid branching *Escharella argus*, d'Orb., has an aperture of the Cellarian shape, with four teeth, just like *Cellaria crassa*, and the ovicell is also concealed in a similar manner. Reference to *Escharipora rhomboidalis*, d'Orb., will also show the relationship. I have previously pointed out that the young branches of *Cellaria* at first have the calcareous wall continuous with the parent joint, and the chitinous articulation is formed subsequently; but as some correspondents were unable to verify this, I can only suppose through lack of suitable material, I give a figure taken from a photograph.

This can, however, readily be seen in *C. fistulosa* and any of the common species.

I have pointed out (p. 89) that this is by no means confined to *Cellaria*, but occurs in other articulated species, and supports the idea that articulated forms are derived from unarticulated ones.

In the Crag and other Pliocene formations of Europe *C. crassa* is found with the branches continuous, or, as Mr. Busk says, with a tendency to ossification, which does not seem a fortunate method of indicating what takes place, as we must not suppose that there has ever been a joint.

Loc. Cumberland Island; Cape Capricorn; Victoria; Station 186, 8 fath. (Torres Straits); Holborn Island; off Raton, New Guinea, 7 fath.

20. *Farcimia oculata* (Busk).

Nellia oculata, Busk, Cat. Mar. Polyzoa, p. 18, pl. lxiv. fig. 6, pl. lxv. (*bis*) fig. 4; 'Challenger' Report, p. 27; Smitt, Floridan Bryozoa, p. 3, pl. i. figs. 53, 54; Haswell, Polyzoa from Queensland, p. 36; MacGillivray, Zool. Vict. dec. v. p. 51, pl. xlix. fig. 5; Hincks, Journ. Linn. Soc., Zool. vol. xxi. p. 121.

This was placed at first by Busk in the family Cellariidæ;

but in the 'Challenger' Report he places it under Cellulariadæ, although in the definition of the family he says "zœcia—all facing the same way." Mr. Hincks, in his Brit. Mar. Polyzoa, p. 35, seems inclined to place it under the Cellulariadæ; but his *Farcimia appendiculata*, which is no doubt closely allied, he places under Cellariidæ. The characters are so decidedly Membraniporidan that I called a variety *M. oculata*, var. *spinosa* (Quart. Journ. Geol. Soc. vol. xxxix. p. 434, pl. xii. fig. 22), and I now reluctantly remove it, but do so as it ought to be classified with *F. appendiculata*, H.; *F. cereus*, Pourt.; *F. lusoria*, Waters.

Loc. Torres Straits; Bass's Straits; Florida; Victoria; Cape Grenville, North-east Australia, 20 fath. (*W.*); Piper Islands, 9 fath. (*W.*); 'Challenger' Stations 190, 188, 208, 148, 151, 18–550 fath., being from Heard Island, Crozet Island, the Philippine Islands, and off Bahia; Mergui Archipelago (*H.*); Ceylon (*H.*).

21. *Flustra dissimilis* (Busk).

Carbasea dissimilis, Busk, Cat. Mar. Polyz. p. 51, pl. l. figs. 4–7; MacGillivray, Zool. Vict. dec. v. p. 28, pl. xlv. fig. 3.

Loc. Tasmania (*B.*); Queenscliff; King's Island; Port Phillip Heads (Victoria); Shoalhaven Beach (New South Wales).

22. *Flustra cribriformis* (Busk).

Carbasea cribriformis, Busk, Brit. Mus. Cat. p. 51, pl. lxviii. fig. 1; 'Challenger' Report, p. 58, pl. xxxiv. fig. 8; Haswell, "On some Polyzoa from the Queensland Coast," Proc. Linn. Soc. N. S. Wales, vol. v. p. 37.

A fine specimen from Darnley Island has no radicle-tube at the lower angle of each fenestra, nor is there any indication of such a structure; and as Mr. Busk mentions this in his 'Challenger' specimens, we must conclude that, according to the conditions under which it grows, it is with or without attachment.

On the dorsal surface the central part of each zœcium is thin and the remainder is covered with wavy lines of growth.

Loc. Cumberland Island; Station 186, Cape York, 8 fath.; Station 188, 28 fath.; Station 190, 45 fath.; Holborn Island (*H.*); Darnley Island, Torres Straits, 30 fath.

23. *Flustra militaris*, sp. nov. (Pl. IV. fig. 2.)

Zoarium bilaminate, fronds long and rather narrow, with about eight zœcia in a transverse row. Ovicell large, raised,

with a median rib, and on each side of this an irregular area. On each side below the ovicell two thick club-shaped spines.

The ovicell is composed of two calcareous layers, the under one smooth, so that when the upper one is removed no trace of the area is shown. The structure of the ovicell in *Flustra episcopalis* is just the same, and no doubt the two species are allied; but in *F. episcopalis*, B., the operculum is entire, whereas in the present species it is of the Membraniporidan type. There is a thick tubular growth down the side of the zoarium of *episcopalis*.

On account of the prominent spines I call this *militaris*, in opposition to the less-armed *F. episcopalis*.

Mr. Hincks defines *Flustra* as with the ovicells immersed; but in the two species considered they are much raised.

Loc. Port Jackson (New South Wales).

24. *Diachoris spinigera*, MacG.

Diachoris spinigera, MacGillivray, Trans. Roy. Soc. Vict. 1859, vol. iii. p. 165, pl. ii. fig. 12; Zool. Vict. dec. v. p. 32, pl. xlvi. fig. 3.

The specimen from Shoalhaven Bay has the zoœcia suberect; the spines are mostly towards the distal end, often only two or three on each side; on one side only an avicularium with a prominent beak. There is considerable irregularity in the number of spines, and from this specimen I consider that *D. distans*, Hincks, is too closely allied to be separated as a species.

Loc. Wilson's Promontory; Portland (Victoria); Shoalhaven Bay, 8 fath. (New South Wales).

EXPLANATION OF PLATE IV.

Fig. 1. *Menipea cervicornis*, MacG., var., × 25.
Fig. 2. *Flustra militaris*, sp. nov., × 16.
Fig. 3. *Bugula neritina* (L.), with avicularia. From Ball's Head. ×16.
Fig. 4. Sketch of *Caberea lata* (p. 84), showing chitinous tubes at the junction, × 12.
Fig. 5. *Micropora ratoniensis*, sp. nov., × 16.
Fig. 6. *Cellaria gracilis* (B.), showing continuous calcareous wall before the articulation is formed. The chitinous tubes are just commencing. × 25. From Holborn Island.
Fig. 7. Sketch of *Canda arachnoides*, Lamx., showing chitinous tubes at the articulation. × 25.
Fig. 8. *Membranipora Savartii*, Aud.?, × 16. From Darnley Island.
Fig. 9. Operculum of *Catenicella alata*, W. Thoms., × 85.
Fig. 10. Operculum of *Catenicella hastata*, B., × 85.
Fig. 11. Operculum of *Catenicella delicatula* (Wilson), × 85.
Fig. 12. Operculum of *Catenicella Buskii*, W. Thoms., × 85.
Fig. 13. Operculum of *Catenicella ventricosa*, B., × 85.

Fig. 14. Mandible of *Bugula dentata* (Lamx.), × 85.
Fig. 15. Mandible of *Bugula neritina* (L.), × 85.
Fig. 16. Mandible of *Bugula Murrayana*, Johnst., × 85.
Fig. 17. Mandible of *Bugula capense*, × 85.
Fig. 18. Mandible of *Catenicella geminata*, Th., × 250.
Fig. 19. The same, × 85.
Fig. 20. Lateral wall of *Didymia simplex*, B., showing rosette-plates.
Fig. 21. Operculum of *Calpidium ornatum*, B., × 85.
Fig. 22. Operculum of *Catenicella geminata*, Th., × 85.
Fig. 23. Operculum of *Porina* (?) *inversa*, sp. nov., × 250.
Fig. 24. Mandible of *Lunulites cancellatus*, B., × 250.

VIII.—*On new Reptiles and Batrachians from North Borneo.*

By G. A. Boulenger.

A small collection of Reptiles and Batrachians formed by Mr. John Whitehead on Mount Kina Baloo consists of ten species, four of which are new and described below. The known species are the following:—*Lygosoma variegatum*, Ptrs.; *Lygosoma olivaceum*, Gray; *Tropidonotus sarawacensis*, Gthr.; *Rhacophorus maculatus*, Gray; *Bufo leptopus*, Gthr.; and *Leptobrachium gracile*, Gthr.

Draco obscurus.

Head small; snout as long as the diameter of the orbit; nostril directed upwards, perfectly vertical; tympanum naked, smaller than the eye-opening; eleven upper labials. The male's gular appendage as long as the head, covered with large scales. No nuchal fold or crest. Dorsal scales smooth, equal, not larger than ventrals; a lateral series of widely-distant, enlarged, keeled scales. The fore limb stretched forward extends considerably beyond the tip of the snout; the hind limb reaches the shoulder. Brown above, with black spots on the nape; wing-membranes blackish above, colourless inferiorly; throat brown, with light spots; gular appendage brown, black at the base; lower surface of lateral wattles dark purple.

	millim.
Total length	256
Head	17
Width of head	11
Body	75
Fore limb	42
Hind limb	52
Tail	164

A single male specimen.

Tropidonotus flavifrons.

Dentition syncranterian. Head oval, very distinct from neck; snout short; eyes moderate. Scales in 19 rows, feebly keeled, of outer row smooth. Ventrals 146; anal entire; subcaudals 95. Internasals truncated in front, about half as large as the præfrontals; one præ- and two postoculars; loreal as deep as broad; eight upper labials, fourth and fifth entering the orbit; two superposed anterior temporals. Olive above, with dark network; two alternating series of white spots along each side, upper on the sixth scale from the ventral, lower larger and on the outer border of the ventral; a large yellow spot covers the forehead (præfrontals, loreals, præoculars, and anterior half of frontal); sutures between the labials black; ventrals whitish, with large black spots; the black predominates on the subcaudals.

Length to vent 300 millim.; tail 153.

A single specimen.

Rana Whiteheadi.

Vomerine teeth in two oblique groups just behind the line of the choanæ. Head large; snout obtusely acuminate, projecting, with angular canthus rostralis and deeply concave loreal region; eyes very large; interorbital space narrower than the upper eyelid; tympanum half or three fifths the diameter of the eye. Fingers moderate, first extending slightly beyond second; toes moderate, entirely webbed; disks well developed, about two fifths the diameter of the tympanum; subarticular tubercles small; a small oval inner metatarsal tubercle. Hind limb very long, the femoro-tibial articulation reaching the shoulder; tibia as long as the distance between the orbit and the vent. Skin nearly smooth; an interrupted glandular lateral fold from the eye to the sacrum. Grey-brown above, with rather ill-defined darker cross bands on the limbs; tympanum reddish; upper lip and lower surfaces whitish. Male with an external vocal vesicle on each side of the throat, below the commissure of the jaws; no humeral gland.

From snout to vent 46 millim.

Four male specimens.

The nearest ally of this species is *R. jerboa*, Gthr., which differs in having longer hind limbs, a shorter, blunter, and less projecting snout, smaller eyes, &c.

Ixalus latopalmatus.

Snout very short, broadly rounded, obliquely truncate at the end, with nearly vertical, concave lores; eyes large; interorbital space as broad as the upper eyelid; tympanum very small, not very distinct. Fingers short, dilated into enormous disks, the width of which equals three fourths the width of the eye; a broad web, extending nearly to the disks, between the two outer fingers, and a short one between the second and third; toes very broadly webbed, the web enclosing one half of the disks; latter about half the size of those of the fingers; subarticular tubercles oval, flat; no distinct metatarsal tubercle. Hind limb very long and strong; the femoro-tibial articulation reaches the shoulder; tibia as long as the distance between the tympanum and the vent. Skin finely granulate above, smooth inferiorly. Blackish above, with pale brown variegations on the back and whitish dots on the sides; limbs with lighter cross bands; hinder side of thighs blackish, speckled with whitish; lower surfaces whitish.

From snout to vent 53 millim.

Two specimens, female and half-grown.

IX.—*Notes from the St. Andrews Marine Laboratory (under the Fishery Board for Scotland).*—No. VII. By Prof. M'Intosh, M.D., LL.D., F.R.S., &c.

1. On the Occurrence of Peculiar Gelatinous Bodies in Profusion.
2. On *Syncoryne decipiens*, Dujardin.
3. On the Commensalistic Habits of the Larval Forms of *Peachia*.
4. On the Presence of Swarms of Appendicularians.
5. On the Occurrence of *Clione borealis*, Pallas.

1. *On the Occurrence of Peculiar Gelatinous Bodies in Profusion.*

Pelagic colonial Radiolarians on the surface of tropical, subtropical, and, generally speaking, the warmer seas have been familiar for a long time, especially since the observations of Prof. Huxley * drew special attention to the group. These

* "Zoological Notes and Observations made on board H.M.S. 'Rattlesnake.'—III. Upon *Thalassicolla*," Ann. & Mag. Nat. Hist. ser. 2, vol. viii. p. 433.

and similar organisms have, however, attracted little notice in the seas of our own country, probably from the fact that the ordinary tow-net has chiefly been used in examining the pelagic fauna. The large mid-water net formerly mentioned in this journal will, however, make a considerable revolution in this respect, since it demonstrates that many forms of great interest float in mid-water or near the bottom, which forms would entirely escape the ordinary tow-net as well as the dredge and the trawl. One may indeed be excused for imagining what the results of such an apparatus would have been if perseveringly used during the unparallelled opportunities afforded on board H.M.S. 'Challenger.'

In the midst of the profusion of forms captured by the mid-water net on the 13th May a peculiar appearance was caused in the water by certain small gelatinous structures—ovoid, dumb-bell-shaped, or somewhat cylindrical in outline. Their size varied from 1 to 2 millim. in their long diameter, and thus they were much smaller than examples of *Collozoum inerme*. When conveyed to the laboratory they floated somewhat heavily near the bottom of the glass vessels, though it is possible their range in the open sea varies in depth according to circumstances. They presented a hyaline gelatinous matrix, in which were studded small greenish-yellow cells containing nuclei, and many of which, from their constricted aspect, appeared to be in a state of division. Occasionally somewhat large, round cells with nuclei occurred amongst the others. In some examples, again, minute acicular bodies like spicules were sparsely scattered throughout the protoplasm, resembling those of *Sphærozoum neapolitanum* as figured by Brandt (pl. v. fig. 64) *. After preservation in spirit the latter became finely granular in the centre, and were rendered invisible when the preparation was mounted in calcium chloride.

These gelatinous masses were in vast quantities in the bay, and could not fail, whether Radiolarians or otherwise, to have an important influence on the fauna, especially the pelagic fauna, and thus indirectly on the food of fishes. Hitherto it has been chiefly Radiolarians with a conspicuous siliceous capsule that have attracted notice in the alimentary canals of Invertebrates (*e. g.* in the Annelids dredged by the 'Challenger'), and, indeed, the group is only incidentally mentioned in Prof. Ryder's 'Protozoa' in relation to the food of fishes †. In the present instance

* "Koloniebildende Radiolarien," Fauna u. Flora des Golfes von Neapel, xiii. Monographie (1885).

† "The Protozoa and Protophytes considered as the Primary or Indi-

it is probable that *Tomopteris*, which occurred in great beauty at this time, the Appendicularians, and other forms fed largely on the gelatinous masses. In relation to the surrounding fauna, again, it is interesting that Brandt, in his elaborate and beautiful monograph on the colonial Radiolarians, mentions that certain forms (e. g. *Myxosphæra cærulea*) frequently contain a parasitic Amphipod (*Hyperia*) as well as Copepods and Appendicularians, while living diatoms occurred in young *Collozoa*. At St. Andrews all these forms were present with the gelatinous masses, but quite separate from them.

While engaged with this form it was observed by a note in 'Nature' * that Mr. Shrubsole had found at Sheerness-on-Sea that the water "became foul in May from the presence of gelatinous masses of small size and spherical, cylindrical, and irregular forms, in which nucleated granules are imbedded. After immersion, even for a few seconds, ropes, nets, &c. feel as if they had been dipped in glue." The fishermen moreover were of opinion that this injured the tackle and lessened the take of some kinds of fish. It continues for a month and then disappears. At my request Mr. Shrubsole courteously forwarded specimens of the water and the deposits, with outlines of the form in life, and there can be little doubt that this is a similar gelatinous structure, which thus appears in vast numbers and again disappears. The injury which is asserted to be done to the tackle would require further investigation; but the diminution of the take of certain kinds of fish from this cause is probably hypothetical †.

2. *On* Syncoryne decipiens, *Dujardin*.

In alluding to the Cœlenterate pelagic fauna in the February number of this journal special mention was made of the immense abundance of the Hydromedusæ, the water of such bays throughout the greater part of the year being crowded with the various forms of *Thaumantias*, *Bougainvillia* ‡,

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rect Source of the Food of Fishes," U. S. Commission of Fish and Fisheries, part ix. 1881 (1884), p. 760.

* July 9, 1885.

† Mr. Shrubsole has drawn my attention to a paper by Count Castracane, entitled "Straordinario fenomeno della vita del Mare" (Atti dell' Accad. Lincei, tome xxxiv. 1881), in which similar bodies appeared in the Italian waters, and which he associated with the inferior Algæ. He does not seem to have observed spicules.

‡ *Bougainvillia britannica*, so exquisitely figured by Prof. Allman ('Gymnoblastic &c. Hydroids,' i. pl. ix. fig. 8), being specially abundant.

Circe (probably *C. borealis*), *Sarsia*, *Turris*, *Oceania*, and others—not at the surface, but very often at a depth of 3 or 4 fathoms. Occasionally, indeed, certain conditions of the wind and tide strew the beach in May with masses of *Thaumantias* and other forms; but they may exist in great profusion, while only a few stragglers are caught by the ordinary tow-net.

The active planulæ from a vessel containing abundance of *Sarsiæ* amongst *Thaumantias* and other forms noted were placed under a trickle of water on the 30th July, 1886. Some time afterwards many minute pale hydroids were noticed on the bottom of the vessel; but it was not till the first week in March 1887 that a delicate hydroid was observed stretching over the bottom of the vessels. This period would nearly correspond with that at which Dujardin originally found the *Syncoryne* proceeding from the pelagic *Sthenyo* *. Further examination showed that these growths were formed by a single species, viz. the *Syncoryne decipiens*, Dujardin, the faithful pencil of the late Mr. Alder leaving little to be desired in the figure in Mr. Hincks's work. It is clear therefore that either the planula of this species alone had been selected for the experiment, which is unlikely, or that it survived frequent vicissitudes which caused the others to succumb.

As Mr. Hincks had no opportunity of examining living specimens, it may be noted that the minute and slender stem (hydrorhiza) creeps over the surface of the glass often in a somewhat radiate manner, sending off here and there free erect branches, which bear the characteristic polypites at the tip. These have for the most part the general aspect of Mr. Alder's figure †; but the slender transparent tentacles are much longer in vigorous adults, and thus contrast with the large globular or button-like tip with its prominent thread-cells. The elongated oral region of the polypite is pronounced, and the dilated region behind it is tinged of a pale brownish hue. Small rounded bodies, of a pale brownish-red colour, situated in most just behind the tentacles, though in others they occur amongst the tentacles, indicate the gonophores.

The polypary shows more evident crenulations (annulations) than represented in the figure, and towards the beginning of July this had undergone various changes in the colonies. Many of the chitinous sheaths were empty, while here and there, out of the wall of the effete tube, sprouted a slender band

* Ann. des Sc. Nat. 3e sér. iv. p. 277 (1845).

† Hincks, Brit. Hydr. Zooph. ii. pl. x. fig. 2.

of cœnosarc, with a more or less perfect coating of chitin, terminating in a polypite with two or four tentacles, and provided with the elongated oral tube, which was bent round, apparently in quest of prey, and often dilated at the extremity. Secondary buds, possessing only two tentacles, and thus somewhat approaching the peculiar *Lar sabellarum* in appearance, occurred at intervals in the course of the former. The cœnosarc connected with these young buds entered portions of the tubes forming the old polypary; and sometimes terminated abruptly in a bulbous mass, in the interior of which the cilia were specially active. Dujardin states that the species feeds especially on *Cyclops* and other minute Crustacea. If the polypites inhabiting these older sheaths had died on the escape of the free zooids, or from causes connected with their artificial life, the vitality of the cœnosarc had enabled the species again to make rapid progress by gemmation.

3. *On the Commensalistic Habits of the Larval Forms of* Peachia.

Considerable information has recently been obtained concerning the history of larval Actiniæ commensalistic on Medusæ both in our own and foreign seas. Much of this has been collected by Prof. Haddon in his very interesting account of the parasitic larva of *Halcampa* *, which he found for the most part attached to the stomach on the sub-umbrella of different species of Leptomedusæ. Before the publication of the latter paper, however, the occurrence of considerable numbers attached to various kinds of *Thaumantias* in St. Andrews Bay had led me to think that this must be a very general habit of these larval forms, which I associated with the commonest type here, viz. *Peachia hastata*, Gosse, first recognized as a British species by the late Prof. John Reid, of St. Andrews, under the name of *Actinia cylindrica* †. They occurred in various parts of the bay, though the greatest number were procured by a single sweep of the mid-water net off the mouth of the Eden. They cling to various parts of the Medusæ, not only to the regions mentioned by Prof. Haddon, but to the under surface of the disk, and occasionally externally. They appear to adhere to the Medusæ by the sucker-like action of the mouth, which is widely open, though the tentacles are also closely applied to the surface.

The free-swimming larval forms are thus at a subsequent

* Proc. Roy. Dubl. Soc. 1887, p. 473, pl. xi.

† Physiol., Anat., & Pathol. Observations, p. 656, pl. v. figs. 21 and 22 (1848).

stage carried about without effort by the Medusæ; and as there is abundance of nourishment of a suitable kind around, it is not necessary to limit the view only to the possibility of their feeding on *Thaumantias*, for by the use of the tentacles as organs of attachment the mouth may at any time be set free. Further, Actiniæ form a favourite food of many fishes, *e. g.* the cod, haddock, whiting, and others, while the stomachs of flounders are frequently distended with *Edwardsiæ*. The floating larvæ of *Peachia* thus increase the supplies for the pelagic young of the food-fishes, and borne near the sand by the Medusæ, are placed within easy reach of the active Pleuronectidæ.

4. *On the Presence of Swarms of Appendicularians.*

Appendicularians have long been familiar in Scottish waters. Thus Edward Forbes, when off the north coast of Scotland in 1845, found that the cloudy patches of red colouring-matter in the water consisted almost entirely of the bodies of the "curious and anomalous creature called *Appendicularia*" *. During the expeditions in connexion with the Trawling Commission, so ably presided over by Lord Dalhousie, Appendicularians were frequently met with in the ordinary tow-nets, which were sunk by a heavy weight a fathom or two in the water. Most of us, however, were unaware that in April and early May at any rate the inshore waters occasionally teem with this interesting type—so profusely, indeed, that they and their "houses" are ready to rupture the huge mid-water net. Their activity when fresh can only be compared to that of spermatozoa, as they dash everywhere through the water either in a complete state or only represented by tails. None of these showed the pinkish hue so often seen in 1884, yet the reproductive organs were fairly developed. They also evidently feed freely, as the glass vessels in which they were kept were littered with small brownish, cylindrical, fæcal masses, which at the time were associated with the pale greenish gelatinous masses described under No. 1 altered by digestion. During the month in which they were more or less under observation in the bay their size increased considerably. Their disappearance again in May was apparently as sudden as their advent in such enormous numbers in April.

It is noteworthy that some, such as Prof. Huxley, have failed to capture them in their "houses," though, as in the latter case, the animals themselves were in vast numbers on

* Hist. Brit. Mollusca, vol. iv. p. 245.

the coast of New Guinea and in the southern Pacific *. The "houses" were a serious impediment to the use of the mid-water net at St. Andrews, and the empty ones frequently formed a thick coating on the surface of the large jars in the laboratory, probably because bubbles of air had been mixed with them.

Prof. Herdman tells me that the examples from St. Andrews are as large and fine as those procured by the 'Challenger,' and he identifies the species with "*Oikopleura cophocerca.*" The beautiful outlines of the *Appendicularia* (a generic name which I agree with Prof. Huxley should be preferred to the *Oikopleura* of Mertens) in life, however, differ considerably from Gegenbaur's figures of his species †. More recent authors have in all probability improved in this respect.

5. *On the Occurrence of* Clione borealis, *Pallas.*

The use of the mid-water net on the 11th and 12th April and for a week or two subsequently brought to the laboratory a considerable number of active specimens of *Clione borealis*, Pallas. They generally came from a depth of 4 fathoms in from 6 to 8 fathoms water. This Pteropod altogether escaped notice in the far-reaching dredging-excursions of the late esteemed Dr. Gwyn Jeffreys, who searched the British seas more thoroughly than any other in recent times, and on this account therefore its presence is the more noteworthy and an agreeable surprise to Mr. Prince and myself. Dr. Gwyn Jeffreys states, under the group Gymnosomata ‡, "The only member of this order which seems to have been observed on the British coasts is *Clione papilionacea* of Pallas (*Clio borealis*, Bruguière, = *Clio retusa*, Müller and Fabricius), a native of the Arctic Seas, and partly the reputed food of the true whale. Dr. Leach says that during a tour to the Orkneys (query Hebrides?) in 1811 he found several mutilated specimens on the rocks, and succeeded in capturing one alive while rowing along the coast of Mull. Dr. Mörch reminds me that in the 'Isis' for 1823 (ii. p. 459) Oken mentions a specimen in the Museum of the Jardin des Plantes from Falmouth, and that Faber noticed this mollusk as found in the Cattegat at Lessö."

Nothing could exceed the beauty of these Pteropods and the interest excited by their movements. The general mass

* Phil. Trans. 1851, part ii. p. 598.
† Zeitschr. f. wiss. Zool. vi. p. 408, Taf. xvi. figs. 1–5 (1851).
‡ Brit. Conchology, v. p. 121.

of the body is translucent, while from the anterior end a bar of rich reddish orange proceeds backward a short distance behind the epipodia. The tip of the tail again is flecked with reddish-brown pigment-grains. As Pallas first noticed, the muscular bands of the epipodia are so arranged as to give the organs the aspect of a file or rasp, as in *Cymbulia*, from their intimate decussation, and their mobility is remarkable. The animals mount gracefully from the bottom of the vessel and steer for the surface, or in a circle, the tips of the epipodia almost touching ventrally and again dorsally—just as a lithe swimmer would do in the erect position in the water by alternately touching the tips of his fingers in front and (if he were able) behind. In the case of *Clione*, however, the locomotive organ is a broad muscular wing on each side, the curves of which so strike the water as to cause the easy graceful motion so characteristic of the species.

The only Pteropod hitherto found on the eastern shores of Scotland is *Spirialis retroversus*, Flem., which occasionally occurs in vast numbers, as mentioned in the February number of this journal *. It is equally abundant on the western shores. So rare are other forms that in our experience only one other species has been met with, viz. that termed by Dr. Gwyn Jeffreys *Clio pyramidata*, Browne, which had been carried by the Gulf-stream in August to a quiet bay in North Uist.

X.—*Some new Hypotrichous Infusoria from American Fresh Waters.* By Alfred C. Stokes, M.D.

[Plate III.]

Litonotus vermicularis, sp. nov. (Pl. III. fig. 1.)

Body elongate, flattened, from fifteen to twenty times as long as broad, soft, flexible, and elastic, widest centrally, tapering thence to the rounded posterior extremity, and anteriorly to the subapical constriction ; the frontal border obliquely rounded; ventral surface longitudinally striate ; dorsal aspect ordinarily traversed by a narrow, longitudinally disposed, keel-like ridge; contractile vesicles multiple, thirty or more arranged in a single series near one lateral border, from eight to ten scattered and disposed near the opposite lateral margin ;

* 'Annals,' Feb. 1887, pp. 140–141.

nucleus moniliform, the nodules ovate, numerous; trichocysts abundant, most conspicuously developed as a dense, radiating series within the frontal border; anal aperture at some distance from the posterior extremity; endoplasm granular. Length of the extended mature body $\frac{1}{60}$ to $\frac{1}{30}$ inch.

Hab. Standing pond-water.

The largest and mature zooids are visible to the naked eye as fine white threads gliding through the water.

Chilodon vorax, sp. nov. (Pl. III. fig. 2.)

Body suboval, soft and flexible, twice and a half as long as broad, widest anteriorly, and curved towards the left-hand side, gradually tapering from the sinistral concavity to the rounded posterior extremity, the left-hand border slightly convex, the lip-like projection obtuse or rounded; cuticular surface longitudinally striate; nucleus elongate-ovate or subfusiform, located in the posterior body-half, usually near the right-hand lateral border; contractile vesicles multiple, small, spherical, scattered; an undulating line of cilia extending from the lip, beyond which it frequently projects, to the oral aperture; anal aperture dorsal, near the posterior extremity. Length of body $\frac{1}{125}$ inch.

Hab. Fresh water, with *Oscillaria* and other algæ in early spring.

The rod-fascicle lining the pharyngeal passage is not only somewhat protrusible, as in the other members of the genus, and expansile and contractile at the distal extremity, but it is also freely movable within the body-sarcode around the margin of oral attachment as a centre. The Infusorians under observation fed voraciously on certain linear diatoms (probably a species of *Nitzschia*) with which the water teemed, the frustules often being considerably longer than the body of the animalcule in its normal condition, and, after being engulfed, consequently extending through the entire length of the Infusorian, and stretching the cuticular surface at both extremities until at these points the limiting membrane became the merest film. Before the process of engulfing was actually witnessed it was an interesting problem as to how the diatom became freed from the posterior region of the pharyngeal passage which extends almost to the centre of the body. The first supposition was that the posterior extremity of the body was sufficiently protruded under the pressure of the inflexible diatom to allow the latter to pass from the pharynx and then to glide forward, thus partially relieving the posterior pressure. This supposition was not correct. During the passage of the frustule, when the cuticular surface of the rear margin

of the body has reached its limit of extension, the pharyngeal tube, containing one end of the long diatom, suddenly and violently rotates forward until its normal position is completely reversed, and the diatom consequently slips out. The act is probably only to a certain extent voluntary, being effectually aided by the strong pressure from the extended cuticular surface, which tends to force the pharyngeal fascicle forward. This pressure is, however, not essential, as the pharyngeal tube is freely movable at the animalcule's will. I have seen it suddenly swing forward to free itself and as quickly swing back into its former and normal position. The latter act is evidently entirely voluntary*. Reproduction is by oblique transverse fission. The animalcule was abundant in its habitat.

Loxodes magnus, sp. nov. (Pl. III. fig. 3.)

Body elongate, depressed, seven or eight times as long as broad, very soft, flexible, and elastic; narrowest anteriorly, the frontal border rounded and curved toward the left-hand side, the apical extremity terminating in a short beak-like extension; posterior extremity rounded; lateral margins somewhat convex; ventral surface flattened and longitudinally striate, the dorsal convex; adoral groove occupying about one seventh of the anterior lateral margin of the ventral surface, the membranous sickle-shaped lining conspicuous, the posterior portion long and narrow; refractive corpuscles numerous, arranged in a single longitudinal series near the right-hand lateral border; nuclei multiple, irregularly distributed; contractile vesicles apparently many and posteriorly located, but not positively identified; endoplasm vacuolar; colour brown; cilia and dorsal hispid setæ numerous, short, and fine. Length of extended body $\frac{1}{40}$ inch.

Hab. Standing pond-water. Movements gliding, with frequent twisting and folding of the body.

This is readily distinguishable from the two previously recorded species by its great size and by the number of the marginal refringent corpuscles. The nuclei, or those nodules which I have considered to be the nuclei, are much paler in tint than the corpuscles just referred to, larger, and the centrally placed nucleolus in each is more finely granulate. A funiculus probably exists, although it was not positively observed. The posterior portion of the chitinous pharyngeal membrane often appears to be scarcely more than a brown filament, so narrow is it. Its general course is shown in the

* See 'The Microscope,' vol. vi. p. 121.

figure, but it not rarely is more or less undulate. This Infusorian, like all the members of the genus thus far observed, is essentially a bottom-feeder, gliding over the submerged objects, the residual débris at the lowest parts of the shallow waters which it inhabits.

ONYCHODROMOPSIS (*Onychodromus*; ὄψις, form), gen. nov.

Animalcules free-swimming, soft and flexible, hypotrichous; frontal styles six, the anterior three largest and most conspicuous; marginal setæ uninterrupted; ventral styles in four longitudinal rows, the third series from the right-hand body-margin, or the second from the left-hand border, interrupted centrally; anal styles five.

This differs from Stein's *Onychodromus* chiefly on account of the soft, flexible, and uncuirassed condition of the body. In the present form there is no trace of a dorsal shield or carapace, the body being quite soft and flexible, and furthermore bearing on the dorsal cuticular surface numerous short hispid setæ. Stein remarks of the form discovered by him and relegated to the genus *Onychodromus*, that the carapace is more indurated than that of *Stylonychia*, and less so than that of *Euplotes*, which is by no means the condition in the present form. The frontal styles, which, however, are of but secondary importance in generic diagnosis, are from sixteen to twenty-eight in number in *Onychodromus*, and the very important ventral setæ from fifteen to twenty-one; in *Onychodromopsis* the former are six in number, and the latter very numerous and arranged in a characteristic manner.

Onychodromopsis flexilis, sp. nov. (Pl. III. fig. 4.)

Body ovate or subelliptical, about three times as long as broad, somewhat narrowed anteriorly and slightly curved towards the left-hand side; marginal setæ longest and largest at the posterior extremity; ventral styles in four longitudinal rows, the second, counting from the left-hand body-margin, centrally interrupted, consisting of two or three anterior and two or three posterior elements; anal styles five, nearly marginal, often furcate or fimbriate, projecting beyond the posterior border; peristome about one third as long as the body, the inner or right-hand margin bearing a large and, in lateral view, conspicuous membrane; nucleus double, near the left-hand body-margin, but indifferently in the anterior or posterior body-half; contractile vesicle near the centre of the left-hand margin; dorsal hispid setæ short, inconspicuous, and abundant. Length of body $\frac{1}{200}$ to $\frac{1}{277}$ inch.

Hab. Standing pond-water, with *Lemnæ*.

Holosticha vernalis, sp. nov. (Pl. III. fig. 5.)

Body subelliptical, about four times as long as broad, very soft and flexible; both extremities rounded, the anterior lip short, crescentic; the peristome extending backward through about one third of the ventral surface, the right-hand margin ciliate, the adoral series on the posterior half of the left-hand border directed across the peristome-field towards the right hand, the anterior half directed towards the left hand; frontal styles five or six, scattered, the three anterior largest; ventral setæ forming two median rows, beginning in close proximity to the frontal styles; marginal setæ longest at the posterior border, those on the left-hand side gradually leaving the body-margin and approaching the peristome; anal styles from five to eight, usually fimbriated; contractile vesicle spherical, near the centre of the left-hand side; nucleus not observed; dorsal hispid setæ numerous. Length of body $\frac{1}{140}$ inch.

Hab. Shallow pools in early spring, with algæ.

Tachysoma (ταχὺς, swift; σῶμα), gen. nov.

Animalcules free-swimming, soft, and flexible; frontal styles from eight to ten, the three anterior usually the largest; ventral styles five, scattered; marginal setæ at some distance from the lateral borders, interrupted on the posterior margin; anal styles five; caudal setæ none; dorsal hispid setæ usually numerous and conspicuous.

Tachysoma agile, sp. nov. (Pl. III. fig. 6.)

Body elongate oval, about four times as long as broad, both extremities evenly rounded; peristome-field arcuate, extending through about one fourth of the ventral surface, without a right-hand or reflected inner border; marginal setæ in close proximity to the five scattered ventral styles; anal styles five, large, often finely fimbriated, and with a tendency to form two groups, the two elements on the right-hand side usually extending obliquely towards the right; contractile vesicle near the centre of the left-hand body-margin, gibbously extending the region at complete diastole; nucleus double, each ovate nodule with an external subspherical nucleolus; dorsal hispid setæ long, fine, clothing the dorsal surface in several longitudinal rows. Length of body $\frac{1}{375}$ inch.

Hab. Pond-water.

I was at first disposed to identify this with *Pleurotricha echinata* (C. & L.), S. K.; but that form, as suggested by Kent, probably belongs to another genus, being relegated to Stein's *Pleurotricha* with some doubt, as the supplementary

marginal setæ referred to are evidently luxuriantly developed dorsal hispid setæ. The absence of all trace of a supplementary ventral series of styles, together with the softness and flexibility of the body, exclude it from *Pleurotricha*, while the latter qualities and the absence of caudal setæ exclude it from *Stylonychia*, which it otherwise somewhat closely resembles; and, finally, the interruption of the marginal setæ at the posterior border refuses it admission among the species of *Oxytricha*, and from *Histrio* it is further excluded not only by the posterior interruption of the marginal setæ, but by its soft and elastic body. Its proper position is probably between *Oxytricha* and *Histrio*.

Tachysoma mirabile, sp. nov. (Pl. III. fig. 7.)

Body elliptical, less than four times as long as broad, the extremities equally rounded; frontal, ventral, and marginal styles essentially as in *T. agile*, but smaller and more setose; anal styles five, without tendency to form two groups; peristome-field arcuate, extending through about one fourth the length of the ventral surface, reflected or right-hand inner border none; contractile vesicle spherical, near the centre of the left-hand body-margin; nucleus single, elongate, subcentrally located, with an elongate, laterally attached nucleolus; endoplasm granular; dorsal hispid setæ long, most conspicuously developed near the posterior extremity. Length $\frac{1}{450}$ inch.

Hab. Standing pond-water.

This form bears a close resemblance to the first-mentioned member of the genus, differing from it somewhat in size, but most conspicuously in the remarkable nucleus and nucleolus. The latter is so large and so closely resembles the nucleus that the two might be considered a uniquely arranged double nucleus, especially in certain individuals in which the nucleolus has become slightly separated from its lateral attachment. In none of the Hypotrichous Infusoria, so far as I am aware, has a similar nucleus been previously observed.

The movements of the animalcule are rapid and erratic. The body is frequently observed to be laterally curved, which region then becoming somewhat concave, the two extremities thus remotely approach each other. The Infusorian when in this condition often swims by rotation on the longitudinal axis.

Tachysoma parvistylum, sp. nov. (Pl. III. fig. 8.)

Body elongate-ovate, less than three times as long as broad, widest posteriorly, narrowed anteriorly to form a neck-like

region composing about one third the length of the entire body, the frontal lip small; locomotive styles small and short, the frontal ten in number, the anterior three largest; ventral styles five, the posterior two in close proximity to the anal, the three anterior arranged in a single longitudinal series; anal styles five, usually very flexible and active; marginal setæ scarcely projecting except posteriorly; right-hand margin of the peristome-field sigmoid; contractile vesicle spherical, near the centre of the left-hand body-margin; dorsal hispid setæ small and inconspicuous. Length of body $\frac{1}{400}$ inch.

Hab. Shallow pools, in early spring. Movements active.

This agile colourless form is notable for its small styles; they are the most minute that I remember to have observed on any member of the Hypotricha.

Oxytricha bifaria, sp. nov. (Pl. III. fig. 9.)

Body oval, less than three times as long as broad, the right-hand lateral border convex, the left-hand margin flattened, the anterior extremity bearing a prominent, crescentic, lip-like projection, the posterior extremity obtusely pointed, its left-hand margin obliquely rounded; ventral styles five, scattered, the posterior one in close proximity to the anal styles, the latter five in number, forming two distinct and completely separated groups, the most posterior of which is composed of two large styles projecting beyond the body-margin, the anterior cluster being formed of three smaller elements placed above and to the left-hand side of the posterior group, and not extending beyond the margin of the body; peristome reaching to the centre of the ventral surface, the right-hand border ciliate and bearing a narrow membrane, a linear series of endoral cilia depending from the central region of the peristome-field; marginal setæ uninterrupted, longest and largest on the posterior extremity; nucleus double, the nodules large, ovate; dorsal hispid setæ short and inconspicuous. Length of body $\frac{1}{160}$ inch.

Hab. An infusion of hay. Endoplasm granular, brownish and semiopaque. Movements rapid and erratic.

This Infusorian is quite variable in contour, being often evenly oval or elliptical, while other individuals appear with the frontal region somewhat curved towards the left-hand side. The essential characters, however, are constant, and by them the animalcule can readily be recognized as distinct from previously recorded members of the genus, the peculiar and distinguishing arrangement of the anal styles making it easily separable from other *Oxytrichæ*.

The most posterior of the five ventral styles is so intimately connected with the anterior group of anal uncini that careful scrutiny is usually needed to positively observe it. Its functions, however, its habit of curving forward, and its flexibility readily distinguish it from the anal cluster. The elements of the latter are rigid and unbending, only the one on the extreme right usually having great freedom of movement. The extremities of the two forming the posterior group are often fimbriated.

With this, as with *Oxytricha hymenostoma*, there is some appearance of a double peristomial membrane; but it is not conspicuous nor even very distinct.

Oxytricha hymenostoma, sp. nov. (Pl. III. fig. 10.)

Body subelliptical, soft and flexible, about twice and a half as long as broad, both extremities rounded, the left-hand region of the frontal border somewhat oblique, the left-hand body-margin slightly concave anteriorly; lip short, crescentic; frontal styles five uncinate and three setose; ventral styles five—two near the apex of the peristome-field, one central, two near the anal styles; the latter five in number, the three on the right-hand side usually projecting beyond the body; marginal setæ continuous, larger and longer on the posterior border; peristome extending to the centre of the ventral surface, the right-hand margin ciliated and bearing apparently two membranes of unequal width, the left-hand border furnished with a series of very fine paroral cilia; nuclei two, ovate; contractile vesicle spherical, near the centre of the left-hand border. Length of body $\frac{1}{300}$ to $\frac{1}{250}$ inch.

Hab. Hay-infusion. Movements rapid.

The appearance of two peristomial membranes is very distinct, and has been observed in all the numerous individuals examined. Their presence is unique, so far as the *Oxytrichæ* are concerned, and my impression is that such an addition to the not uncommon single membrane has not been previously recorded with any other member of the Hypotricha.

Oxytricha acuminata, sp. nov. (Pl. III. fig. 11.)

Body elongate-lanceolate, soft, flexible, and posteriorly somewhat extensile, about six times as long as broad when extended, the frontal border rounded and projecting as a soft, flexible, prominent lower lip; posterior extremity pointed, tapering; frontal styles eight or ten; ventral uncini five—three anteriorly placed, two near the five anal styles, the

latter scarcely projecting beyond the lateral borders, remote from the posterior extremity; marginal setæ uninterrupted, projecting beyond the body posteriorly only; peristome-field extending through about one fifth the ventral surface, the right-hand border ciliated and bearing an undulating membrane; contractile vesicle occasionally double, one situated near the centre of the left-hand body-margin, the other smaller and placed near the apical extremity of the peristome-field; nuclei multiple (usually four), the nodules ovate, each commonly with an externally attached nucleolus; dorsal hispid setæ long, arranged in about six longitudinal series; endoplasm granular. Length of body $\frac{1}{225}$ to $\frac{1}{150}$ inch.

Hab. Pond-water, with algæ. Movements rapid and erratic.

Oxytricha caudata, sp. nov. (Pl. III. fig. 12.)

Body elongate-ovate, soft and flexible, five or six times as long as broad, the anterior border obliquely rounded and slightly curved toward the left-hand side, posteriorly tapering to the conspicuous, attenuate, pointed, and somewhat retractile tail-like extremity; peristome from one fifth to one sixth as long as the body, the right-hand margin bearing an undulating membrane, the seven or eight adoral cilia bordering the anterior extremity large and setose, radiating when quiescent; frontal styles five, uncinate, with three smaller supplementary setæ; ventral styles five, three anteriorly and two posteriorly placed; caudal styles five, remote from the posterior extremity; marginal setæ uninterrupted, occasionally fimbriated, projecting posteriorly only; nuclei two, ovate, near the left-hand body-margin; the single spherical contractile vesicle situated between the nodules, in close proximity with the left-hand body-margin; hispid setæ forming several longitudinal dorsal rows, prominently projecting laterally. Length of body $\frac{1}{100}$ to $\frac{1}{120}$ inch.

Hab. Standing pond-water, with *Lemna*.

The large, almost uncinate, adoral cilia bordering the frontal region are, when the animalcule is quiescent, to all appearance rigidly extended. They then bear a resemblance to the same appendages so abnormally developed in *Actinotricha*. This Infusorian's movements are rapid, with frequent rather prolonged intervals of rest. So far as I am aware there is no other species of the genus with the attenuate and somewhat retractile tail-like extremity. The species is readily recognizable by these characteristics alone.

Histrio inquietus, sp. nov. (Pl. III. fig. 13.)

Body elongate-obovate, about three times as long as broad, the extremities rounded; marginal setæ uninterrupted; anal styles five, occasionally six, the extremities often finely fimbriated; peristome-field obovate, capacious, slightly curved towards the left-hand side, the right-hand margin ciliate and bearing an undulating membrane continued around the anterior border; nuclei two, ovate; dorsal hispid setæ present. Length of body $\frac{1}{270}$ inch.

Hab. Standing pond-water, with *Lemna*. Movements rapid.

Histrio complanatus, sp. nov. (Pl. III. fig. 14.)

Body subelliptical, much depressed, twice as long as broad, the posterior extremity obscurely pointed, the anterior evenly rounded; frontal lip crescentic, conspicuous; peristome-field extending to near the centre of the ventral surface, the right-hand margin ciliated and bearing a membrane; frontal styles eight, five uncinate, with three smaller and setose; ventral styles five, one central, with two anteriorly and two posteriorly placed; anal styles five, the three on the right-hand side alone projecting beyond the body-margin; marginal setæ uninterrupted, longest and largest posteriorly; nuclei two, ovate; contractile vesicle spherical, situated near the centre of the left-hand border of the dorsal surface. Length of body $\frac{1}{320}$ inch. Dorsal hispid setæ short and inconspicuous.

Hab. Shallow pools in early spring.

The position of the contractile vesicle beneath the cuticular surface of the dorsum is well marked, and the enclosed fluid is evidently expelled through that surface.

As in most of the Hypotricha possessing what has been called the upper lip, this part is really not a continuation of the dorsum, but more nearly of the ventral surface, and the adoral cilia lie above the projection until they leave the anterior border to pass to the left-hand margin of the peristome-field. This structural arrangement holds true in a majority of the lip-bearing Hypotricha, I believe in all.

Euplotes variabilis, sp. nov. (Pl. III. fig. 15.)

Body elongate-obovate, nearly twice as long as broad, frontal border truncate; the lip prominent, crescentic; right-hand side of the posterior extremity obliquely truncate or somewhat concave, the left-hand side of that border rounded;

right- and left-hand body-margins usually convex, occasionally flattened and nearly parallel, or slightly concave; dorsal surface minutely roughened, not carinate or furrowed; peristome-field capacious, the posterior extremity of the right-hand border ciliate, the anterior extremity deeply excavate, disposed to be helicoidal; frontal styles six, long; ventral styles three; the two right-hand caudal setæ multifid, the two on the left-hand side simple; anal and frontal styles often fimbriate; nucleus very long, band-shaped. Length of carapace $\frac{1}{160}$ inch.

Hab. Standing pond-water, with *Anacharis*.

The adoral cilia may here be divided into two groups according to the direction of their free extremities, those on the truncate frontal border being directed outwards from that margin, while those on the left-hand side of the peristome-field are habitually vibrated and directed across and above that capacious excavation. The change of position takes place suddenly and is somewhat conspicuous.

The helicoidal flexure of the anterior portion of the peristome-field is variable. At times it is deep and conspicuous; in other individuals it is only a slight notch, while in others again it may appear only as an irregular depression.

EXPLANATION OF PLATE III.

Fig. 1. *Litonotus vermicularis*, × 190.
Fig. 2. *Chilodon vorax*, × 138.
Fig. 3. *Loxodes magnus*, × 120.
Fig. 4. *Onychodromopsis flexilis*, × 280.
Fig. 5. *Holosticha vernalis*, × 210.
Fig. 6. *Tachysoma agile*, × 300.
Fig. 7. *Tachysoma mirabile*, × 415.
Fig. 8. *Tachysoma parvistylum*, × 360.
Fig. 9. *Oxytricha bifaria*, × 256.
Fig. 10. *Oxytricha hymenostoma*, × 350.
Fig. 11. *Oxytricha acuminata*, × 300.
Fig. 12. *Oxytricha caudata*, × 360.
Fig. 13. *Histrio inquietus*, × 490.
Fig. 14. *Histrio complanatus*, × 256.
Fig. 15. *Euplotes variabilis*, × 160.

XI.—*Descriptions of new Species of Heterocerous Lepidoptera (Pyralites) from the Solomon Islands.* By Arthur G. Butler, F.L.S., F.Z.S., &c.

The following species, collected by Mr. C. M. Woodford, appear to be new to science.

Pyralidæ.

1. *Pyralis repetita*, sp. n.

Allied to *P. nannodes* and *P. tenuis*: primaries pale cupreous brown, irrorated with olive-brown, shining; basal two thirds of costa deep blood-red, flecked with oblique ochraceous dots or minute dashes; a slightly inarched dark brown line across the basal third and a nearly straight transverse line of the same colour across the external third; fringe flesh-pink, with a yellowish basal line, two grey-brown stripes, and silvery white edging: secondaries paler than primaries, but with similar fringe, the two lines grey, slightly irregular, subparallel, at basal fourth and middle of the wings: body pale cupreous brown, with the head and front of thorax vinous brown. Under surface paler than above, more uniformly sericeous, the markings not so well defined; palpi golden brown, collar and anterior coxæ vinous brown. Expanse of wings 20–23 millim.

Alu.

2. *Stericta* (*Glossina*, Guén.) *evanescens*, sp. n.

Allied to *S. divitalis*; considerably larger, the pale bands on primaries much wider apart and far more strongly denticulated; pale sap-green with a brassy gloss, the centre of internal and external areas white; markings black or brown and black, as follows:—three conical dots in an oblique series at base, an oval spot on costa with a crescent below it, two small spots beyond the latter (marking the outer boundary of the inner pale band, which is ill defined), a third spot at end of cell; an angular series beyond the middle (indicating the inner boundary of the outer pale band) and a large bifid subapical spot; external area pale brownish, excepting in the centre, with a marginal series of black spots; fringe almost white: secondaries vinous brown, sericeous, with white fringe: head and thorax pale sap-green; abdomen pale sericeous brownish. Under surface pale brassy brown, the anterior half of each wing suffused with bright brick-red; a pale-bordered, angular, greyish stripe beyond the middle; legs sprinkled with reddish scales, palpi and collar ochraceous. Expanse of wings 46 millim.

♀. Alu.

Siculodidæ.

3. *Microsca? pusilla*, sp. n.

Allied to "*Pyralis? polygraphalis*" *; whitish stramineous, with rust-red markings: wings sparsely reticulated, especially the primaries; an imperfect band across basal fourth; an externally sinuated band near the middle of the wings; a broad, external, diffused border to primaries, and a submarginal stripe on secondaries: body pale fleshy brown, the abdomen whitish towards the base. Under surface whitish, the markings much darker than above, the central band and the outer margin of primaries flecked with blackish strigulæ. Expanse of wings 17 millim.

Alu.

4. *Microsca nitens*, sp. n.

Coloration and general aspect of *M. pallida*; sericeous whity brown, slightly inclining to flesh-pink in certain lights; reticulated throughout the wings with dark brown: primaries with a spot near base of interno-median area, a short band from costal to submedian vein at about basal third, a central curved irregular band from subcostal vein to inner margin, and some irregular submarginal spots, pale vinous brown, partly edged with dark brown; subapical area suffused with pale vinous brown; a cuneiform white spot, edged and striated with black, on outer margin at apex; fringe pale vinous brown, spotted with grey: secondaries crossed at about basal third by a slightly irregular band, a little darker than those on the primaries, and an irregular submarginal band, broken up into fragments as on the primaries; fringe as on primaries: abdomen pale vinous brown towards the anal extremity. Under surface silvery whity brown; reticulations more sparse, but blacker than above; the bolder markings copper-brown: primaries with the costal margin crossed at regular intervals by two or four convergent black strigulæ, between which are pairs of longitudinal curved striæ, below each pair of which is a pair of black dots; subcostal area from beyond the middle copper-brown, bounded below by a longitudinal silvery streak, confluent with the apical spot, which is also silvery; below this again is a second (necessarily bent) copper-coloured streak or band; in and beyond

* Two totally distinct species were described by Walker under the name of *Pyralis? polygraphalis*; the above-mentioned (from Swan River) was subsequently named *P. polyphoralis*.

the cell there are a few micaceous scales: body silvery whitish, the legs browner. Expanse of wings 27 millim.

Alu.

5. *Pharambara splendida*, sp. n.

Bone-whitish, mottled with flesh-pink, but most strongly on the secondaries, reticulated throughout with grey, sericeous: primaries with the discoidal cell, but more especially the anterior half of it, leaden grey, this colouring being confluent with a large grey X-shaped marking immediately beyond the cell; a transverse, oblong, greyish spot beyond the middle of interno-median area; fringe spotted with blackish: secondaries with a blackish leaden spot at end of cell, and a second on abdominal margin; fringe spotted with blackish: body above pearly bone-whitish. Wings below with a brilliant silvery gloss, the discoidal cell of primaries sprinkled with opaline scales; all the markings darker, the mottling being of a vinous brown varying to bronze; the reticulations blackish: body below pale vinous brown; legs banded with white. Expanse of wings 22 millim.

Alu.

Asopiidæ.

6. *Ædiodes discrepans*, sp. n.

Closely allied to *Æ. quaternalis*, which it resembles in size and coloration, but from which it differs in the absence of the white spots on the fringe of the secondaries and in the narrower black area between the outer white spots and the outer margin. Expanse of wings 19 millim.

Three specimens, Malayta and Alu.

I had identified this species with that of Lederer, believing that the differences were due to careless drawing; Mr. Meyrick, however, who has seen and sketched the true *Æ. quaternalis*, assures me that the Solomon-Island form is distinct; both insects are black, with four opaline white spots on the wings; the tegulæ white-edged, the face, outer half of antennæ, tarsi, sides of pectus, and two bands on the abdomen pure white, and two white spots on the fringe of primaries.

7. *Desmia ægimiusalis*, var. *conjuncta*.

This form differs from that of Sarawak (and apparently the difference is constant) in the union of the two white spots on the costal and outer margins of primaries into one oblique

white band, thus linking this species to *D. illectalis*. It is possible that *D. conjuncta* may be a distinct species.

Three specimens, Shortland Island.

The types of *D. ægimiusalis* and *D. illectalis* having been both received from the same locality, it is possible that they may be extreme modifications of one very variable species, in which case *D. conjuncta* might be expected to occur in Borneo as a third (intermediate) modification; I therefore hesitate to regard the latter as a species until more examples are received to establish its right to be so regarded.

8. *Heterocnephes felix*, sp. n.

Ivory-white, very slightly pearly: primaries with two bars at the base, an oblique quadrate spot at centre of cell, an 8-shaped patch across the end of the cell, a straight line from the quadrate spot to the inner margin, and a zigzag line from the inner edge of the 8-shaped spot (the area enclosed between these two lines being sordid) shining dark brown; external third of wing of the same colour, divided near its inner edge by a dentate-sinuate white stripe, and further interrupted by whitish longitudinal streaks on the veins, and a white spot at external angle; fringe white, spotted with black, with a basal yellowish line and a black subbasal line: secondaries crossed at base and across end of cell by two dark brown converging lines, which meet at anal angle, the outer line thickened into a large spot at end of cell; a third abbreviated straight line from beyond middle of costa to median vein, external border dark brown, interrupted on anal half by two subconfluent, cuneiform, white patches; fringe nearly as in primaries: antennæ and centre of tegulæ dark shining brown; abdomen dusky, with two spots and a transverse bar at base blackish brown; subterminal segments blackish, anal valves black, with a pure white lateral stripe. Under surface white; wings with markings as above, but of a bronze colour. Expanse of wings 18 millim.

Shortland Island.

Allied to *H. strangulalis* of Snellen, and at first sight very like the *Zebronia perspicualis*=*Botys flexissimalis* of Walker.

Margarodidæ.

9. *Glyphodes deliciosa*, sp. n.

Primaries above black-brown, changing in certain lights to deep shining cupreous; an oblique, pearly white, acuminate, triangular patch from costa, near basal third, to below the

cell; discocellulars pale opaline blue, a spot of almost the same colour on the interno-median area beyond the middle; a large pearly-white patch or abbreviated fascia from costa just before apical third to below first median branch; the extremity of this fascia is conical and its outer edge inarched; a broad, oblique, shining, lilac band from costa near apex to outer fourth of inner margin; a slender, silvery whitish, wavy line between the last two bands; inner border shining snow-white to beyond middle; fringe also snow-white, with three black spots on apical third: secondaries with the basal two thirds pearly white, bounded externally by a slightly irregular, oblique, black stripe (enclosing a silvery whitish line) from outer third of costal margin to anal angle; inner half of external area occupied by a shining lilac band, and outer half by a blackish-brown border; fringe snow-white, marked with blackish, and with a black subbasal line towards anal angle: outer surface of palpi, eyes, and shoulders deep bronzy brown, almost black; face testaceous, with white margins; proboscis, inner side of palpi, and tegulæ pure white; vertex of head sordid whitish, antennæ greyish, thorax dark brown, becoming lilacine greyish behind; abdomen bronze-brown, greyish behind, with blackish lateral stripe and anal tuft and snow-white lateral borders. Wings below without the lilac bands, silvery lines, or opaline spots of the upper surface: primaries with the basal third white, so as to include the oblique white spot of the upper surface; otherwise as above: body below snow-white, with the anal tuft blackish. Expanse of wings 33 millim.

Alu.

Chalcidoptera, gen. nov.

Allied to *Nosophora*, Lederer: primaries elongate-triangular; costal vein terminating just beyond the middle of the costal margin; subcostal five-branched, the first branch emitted some distance before the end of the cell, the second to fourth some distance beyond, the fifth from the end of the cell in the position of an upper radial, and near to the upper radial, the lower radial, second and third median near together from the posterior angle of the cell: secondaries with the costal margin arched nearly to the middle, and thence straight to apex, the outer margin from apex obliquely deflexed and coming to a point at the end of the second subcostal branch, thence suddenly excised and running in a very slight arch to anal angle, whence it curves gently inwards to the abdominal margin. Under surface of secondaries coarsely scaled towards

the base and with a prominent tuft-like ridge of coarse scales in the cell; costal vein absent; subcostal with two branches; discocellulars strongly inangled; radial vein and medians as in primaries: body robust, much elongated; the thorax well advanced in front of primaries; palpi thickly scaled, tapering, nearly erect; antennæ thick, with fine short ciliations; legs long, thick, coarsely scaled, the tibiæ somewhat compressed and very hairy; posterior tarsi also very hairy; spurs of four posterior legs long and of uniform thickness from base to apex; anal tuft bifid, deflexed.

10. *Chalcidoptera rubra*, sp. n.

Rust-red; base of primaries flecked with ochreous, with an unequal ochreous patch across the middle of the cell; a Λ-shaped ochreous marking across the first median branch; a large bilobed, ochreous, and hyaline pearl-whitish patch beyond the cell; a transverse ochreous costal dash, a small rounded spot near external angle, and a small bent apical spot; fringe grey, shot with cupreous: secondaries with pale pearl-grey costal area; base to cell whitish; a large, rounded, hyaline, white spot beyond the cell, and a small, oblique, ochreous dash near middle of outer margin; fringe dark grey, changing to silvery white towards anal angle: proboscis, vertex of head, and antennæ shining whitish; back of thorax and base of abdomen varied with whitish. Under surface whitish, the wings pale golden-yellowish, crossed immediately beyond the hyaline patches by a sinuous brick-red stripe: primaries with a red spot near base of cell, a quadrate blackish spot at end of cell, a black spot on costa near apex, and a large black patch on external border; fringe black; external angle broadly greyish: secondaries with the basal area greyish; the thickened tuft black; apical border broadly black; palpi and tufts of hair on tibiæ red, pectus and femora bright silvery, remainder of legs and abdomen yellowish. Expanse of wings 31 millim.

Alu.

In the arrangement of its markings this species bears some resemblance to *Glyphodes lora*=*Botys luciferalis*, Walk.

11. *Nosophora margarita*, sp. n.

Somewhat resembles *Hoterodes*; dove-grey, the wings with a bright opaline central shot and with the external area shot with pale gold: primaries crossed at about basal fourth by a dark grey line, abruptly bent upon the median vein; a small black spot at outer third of cell and a small linear black dash

on the discocellulars; an oblique, arched, lunulated, dark brown line across disk from outer fourth of costal to outer third of inner margin: secondaries with a black spot at end of cell, a dark greyish brown stripe crossing the wing obliquely just before the middle, and beyond it on the median and radial interspaces a slender trisinuate line of the same colour; all the wings with a few apical, dark brown, marginal spots; fringes pale grey, with a slender ochraceous basal line: head browner and abdomen whiter than the wings. Under surface of wings paler and with less defined stripes than above: body below sericeous; tarsi with a pale cupreous gloss; distal extremity of posterior tibiæ (where it projects from the hairy tufts) bright silvery. Expanse of wings 41 millim.

Alu.

Although this species bears no close external resemblance to *N. chironalis*, it possesses all the structural characters of *Nosophora*. *Botys origoalis*, from the Celebes, is also a *Nosophora* *.

12. *Omiodes pluto*, sp. n.

Dark smoky grey: primaries with paler grey costal margin; base ochreous, interrupted by a large black costal spot and a small silver-grey spot; other markings black, arranged exactly as in *Conogethes punctiferalis*, but those on the secondaries blurred: head pale buff, dusky behind, palpi with a black lateral band; antennæ pale golden buff, deep golden below; collar sordid ochraceous, with lateral and central black spots; tegulæ smoky brown, with a black spot at base; remainder of body leaden greyish, slightly brown at the sides; basal half of abdomen with dorsal and lateral black spots. Wings below sericeous; the fringes silvery; the black markings blurred, wanting towards the base; interno-median area of primaries silvery whitish: pectus silvery; legs and abdomen sericeous, silvery whitish, but the anterior pair of legs with shining, smoky, blackish coxæ, femora, and tibiæ, with pale scaling at the distal extremity of the coxæ; anal extremity of abdomen smoky blackish. Expanse of wings 29 millim.

Alu.

* Lederer refers it to *Cœnostola*, but clearly without having recognized it.

Botydidæ.

13. *Cotochena trinotata*, sp. n.

Near to "*Botys*" *histricalis* of Walker * ; deep ochreous: primaries suffused with brownish, marked with three hyaline white spots in the form of a triangle, the first quadrate, filling outer half of discoidal cell, bounded internally by a straight black stripe and bordered with black externally, the second irregular, almost diamond-shaped, edged behind and in front with black, across interno-median area beyond the middle, the third transverse, trifid, halfway between the cell and outer margin, bounded internally by a black Z-shaped line running to costa, and externally by a more slender zigzag line, which connects it with the second spot; two indistinct pyramidal ochreous spots on the disk beyond the latter line and between the two white spots; outer margin dusky; five blackish spots on the fringe, which is paler on its outer edge: secondaries with a brown dash at the end of the cell and an interrupted, very irregular stripe, represented by three more or less sinuated dashes, across the disk; wing subhyaline beyond each of the brown dashes; margin and fringe as in primaries, but without the black spots: abdomen with pale hind borders to the segments. Primaries below much greyer than above, markings similar: body below whitish, anterior legs banded with blackish. Expanse of wings 25 millim.

Alu.

14. *Haritala* † *pactolica*, sp. n.

Bright chrome-yellow; two black spots on costa of primaries near the base, forming the starting-points for two orange lines which cross the wing; a third larger black spot at end of cell, and a fourth on costa at apical fourth; a brown line, changing at its inferior extremity to orange, runs outwards in a sinuous line from the last spot, curves backwards over the median interspaces, and thence (towards the base) to about the middle of the interno-median area, where it abruptly turns at a sharp angle, and, with a bisinuate, somewhat oblique line, reaches the middle of the inner margin; a slender, black, marginal line: secondaries with an orange >-shaped marking at the end of the cell, and a brown and orange, irregular, discal line, somewhat as on the primaries;

* Walker's "variety" of that species, from China, is a very distinct and beautiful species.

† This generic name was proposed by Mr. Moore to supersede the *Notarcha* of Meyrick (previously used).

a slender black marginal line; fringe traversed by an orange stripe; costal area silvery white: head white between the antennæ; abdomen with pale margins to the segments and white dorsal spots; subterminal segment orange, with large black dorsal spot. Under surface of wings pale golden stramineous, sericeous: primaries with a black spot at the end of the cell, and a second on costa at apical fourth, with the commencement of the sinuous discal line of the upper surface; internal area silvery; margin of wings as above: body below pearly white, anterior tibiæ with a large black spot above on the distal half. Expanse of wings 27 millim.

Alu.

SPILOBOTYS, gen. nov.

General aspect of an enormous *Haritala*, but differing wholly in the structure of the body, which is far more robust and, in the male, much longer, with erect palpi, somewhat as in *Hypotia*, but with much longer exposed terminal joint; the anal claspers enormously developed, projecting considerably beyond the end of the abdomen; widely opened below, so as to exhibit the anal tuft and three powerful central, curved hooks, two lying close together below and one above.

15. *Spilobotys arctioides*, sp. n.

Bright ochreous: primaries with two black spots, placed obliquely at base of costal border; an oblique, more or less excised, greyish, chocolate-coloured band across basal fourth, normally * connected by an internal stripe of the same colour with an outer zigzag, Z-shaped, discal band across external fourth: a spot in the cell, before the middle of the wing, and an outlined dash across the end of the cell of darker brown: palpi grey; antennæ, outer third of tegulæ, and a spot towards their base chocolate-brown; abdomen with four black transverse dashes on each side. Under surface uniformly ochreous; legs greyish. Expanse of wings 50 millim.

Guadalcanar.

16. *Botys aluensis*, sp. n.

Ochreous: primaries with the basal half of costal border greyish; an indistinct, oblique, grey-flecked, orange stripe across basal fourth; a large, oval, dark leaden-grey spot

* In the right-hand wing of the female (which is slightly distorted in its development) the connecting stripe is wanting.

across the middle of the cell; a stripe across external third blackish and transverse from costa to third median, where it bends outwards at right angles, becoming grey with an orange border, then again bent at right angles to below second median branch, again inwards to a point halfway between its commencement and the discoidal spot, and then abruptly downwards to just beyond the middle of the inner margin; the line thus forms what is called a key pattern; outer border greyish, especially on apical half, bounded internally by a blackish interrupted line, less strongly angulated than the discal stripe; a few dusky points on the fringe towards apex: secondaries with an orange dot in the cell; discal line and border nearly the same as on primaries; fringe immaculate: head slightly greyish, collar rather reddish. Wings below pearly golden stramineous, with markings as above, but only the grey and black markings strongly defined, the others obsolete: body white; anterior and middle pairs of legs stramineous in front. Expanse of wings 23 millim.

Alu.

Not unlike *Botys polytesalis* from the Upper Amazons; the angulation of the discal line is like that of *B. inanitalis* (Lederer, Mon. pl. ix. fig. 3).

17. *Pleonectusa aurata*, sp. n.

Bright golden ochreous, with black markings as follows:— primaries with a dot near base of costal vein, an oblique, fairly well-marked line across basal seventh, a dot at centre of cell, an oblique dash at end of cell, and a slightly sinuous, transverse, tapering, discal stripe across external fourth: secondaries with a small oblique dash at end of cell, and a crinkled arched line just beyond the middle. Under surface with the black markings better defined, excepting at base of primaries, where they fail; the veins for the most part also black, and terminating in black dots, the fringes tipped with grey; the discal line of secondaries angular. Expanse of wings 19 millim.

Alu.

18. *Pleonectusa argentata*, sp. n.

Silvery white, slightly pearly towards the base: primaries with a black dot near base of costal vein, a second at centre of cell, and a conspicuous black spot at end of cell. Wings below slightly tinted beyond the middle with golden and with the veins greyish. Expanse of wings 24 millim.

Alu.

Evidently commoner than the preceding species.

XII.—*Description of a new Species of* Nucleolites, *with Remarks on the Subdivisions of the Genus.* By Prof. F. Jeffrey Bell, M.A., Sec. R.M.S.

The Trustees of the British Museum have lately acquired by purchase a small specimen of a species clearly allied to the form which those who use Mr. Alex. Agassiz's 'Revision of the Echini' would call *Nucleolites epigonus*, Mart.; the first point of interest in this acquisition was the locality from which it was derived, for it came, not, like *N. epigonus*, from the eastern seas, but from Nassau in the Bahamas.

But this chorological interest soon paled before the morphological; in *N. epigonus*, it will be remembered, the anal region looks backwards, is elliptical in form, with the long axis vertical, and the periproctal groove is continued to the ventral surface; an essentially similar disposition of the anal region is found in *Echinobrissus recens*. But in the new species we have quite a different arrangement; though the anal region is elliptical in form, the long axis lies transversely, and there is no groove reaching to the ventral surface; in these two particulars it resembles *Rhynchopygus*. *Echinobrissus*, on the other hand, resembles the new form in having the actinostome wider than long, whereas in *N. epigonus* that orifice is longer than wide.

In other characters—the arrangement of the ambulacra and ambulacral pores, the general ornamentation of the test, the delicacy and whiteness of the whole test—*N. occidentalis*, as the new species may be called, and *N. epigonus* agree exactly.

The question first raised by an annectent form such as this may nearly always be stated in the following terms:—Have the generic divisions which have been made been natural? In other words, Have the characters on which genera are based the constancy which makes them of value? That systematists have attached importance to the form and relations of the oral and anal areas is indisputable.

In the latest authoritative work on Echinoids generally—I mean, of course, the chapters on Echinoderms in Zittel's 'Palæontologie'—*Nucleolites* is kept separate from *Echinobrissus*, and is thus defined:—"Wie vorige [*Echinobrissus*], aber Poren nicht gejocht;" but if Prof. Zittel was unable to examine an example of *E. recens*, he should have made use

of the experience of Mr. Alex. Agassiz, who remarks * :— "The mere conjugation of the pores is an insufficient character, as in specimens of *N. epigonus* and of *E. recens* we find in the same individual a petal in which the conjugation is marked, another where it is indistinct, and frequently the corresponding one in which the conjugation cannot be traced;" or of the judgment of Prof. E. von Martens †, "Die seichten, schwer erkennbaren Furchen der vorliegenden Art rechtfertigen eine solche Trennung nicht." Prof. Zittel is not to be congratulated on a step backward from the position taken up by D'Orbigny (Pal. Franç., Crétac. vi. p. 388), Wright, and others as to the synonymy of *Echinobrissus* with *Nucleolites*.

If, however, we are content to accept the rules of nomenclature suggested by the British Association we must use Lamarck's name *Nucleolites* rather than the pre-Linnean (1732) name of *Echinobrissus*, which was suggested by Breynius in his remarkable 'Schediasma.'

But if Zittel's separation of *Echinobrissus* from *Nucleolites* be so little justifiable, does not the transverse long axis of our new species lead us so near to *Rhynchopygus* as to suggest the merging of these forms under one genus? It is difficult to answer this question with certainty; the form of the periproct is, it is clear, not of generic importance; but the much better development of the oral floscelle and the inequality of the constituent rows of pores in the paired ambulacra show that *Rhynchopygus* has gone further in the way of differentiation than has *Nucleolites*; and just as Wright ('Oolitic Echinodermata,' p. 360) keeps, notwithstanding the opinion of E. Forbes, *Clypeus* distinct from *Nucleolites*, on account of the "magnitude and development of the long, wide, petaloidal, poriferous zones," so the greater tendency to a petaloid form and that sure sign of differentiation, inequality in length of the zones, would, even without the characters of the mouth, outweigh the value of the form of the periproct.

It is to be hoped that the structural characters of this new species will be sufficient to attract the notice of the palæontologist, who will, I trust, agree that

(1) *Nucleolites* and *Echinobrissus* are synonymous.
(2) There is nothing to justify even their subgeneric division after the discovery of *N. occidentalis*.
(3) The form of the periproct and of the actinostome are less important, as signs of differentiation, than the

* Rev. Ech. p. 557.
† Archiv für Naturg. xxxii. (1866), p. 180.

characters of the ambulacra and the development of floscelles.

The new species may be defined in the following terms:—

Nucleolites occidentalis.

General form and habit very similar to that of *N. epigonus*, but the long axis of the elliptical anus is transverse, and there is no periproctal groove; the actinostome tends to be pentagonal, but is wider than long; the test is not quite so wide or so swollen posteriorly as in *N. epigonus*.

The length of the single specimen is 17, and its greatest breadth 13·5 millim.

Curiously enough the single test is spineless and bleached, and this (artificially, of course) heightens its resemblance to *N. epigonus*, all known specimens of which are in the same condition.

Hab. Bahamas.

In Coll. B. M.

XIII.—*Description of two new Squirrels from North Borneo.*

By Oldfield Thomas.

Among a collection of small Mammalia made by Mr. John Whitehead during his recent successful expedition to Mount Kina-Balu, and kindly submitted to me for examination, there occur representatives of the two following new squirrels.

Sciurus Whiteheadi, sp. n.

Allied and very similar to *S. exilis*, Müll., but slightly larger, and with the ears, instead of being rounded and short-haired, narrow, pointed, and with beautiful long black-and-white pencils of hair, nearly as long as the head, and standing out conspicuously from the general grey of the body. A white spot also present on the neck just behind the ear. Colour elsewhere precisely as in *S. exilis*. Face without any trace of the black-and-white markings characteristic of *S. melanotis*, Müll. & Schl.

Skull very peculiarly shaped, with a short broad cranial and a disproportionally long and powerful facial portion, the distance from the tip of the nasals to a point between the anterior edges of the orbits 12·8 millim., as compared to about 10 millim. in *S. exilis*, and 11 millim. in *S. melanotis*, the latter an animal with the cranial part of the skull as large as, if not larger than, that of *S. Whiteheadi*.

Teeth: incisors narrow, strongly convex in front, orange above, nearly white below; premolars $\frac{2}{1}$, the anterior upper minute, circular in section.

Dimensions of a skin :—

Head and body 90 millim.; tail, without hairs 53, with hairs 87; hind foot, without claws, 24·5; ears, without hairs 7, with hairs 28.

Skull: tip of nasals to centre of fronto-parietal suture ("bregma") 20 millim.; length of nasals 7·5; interorbital breadth 12; palate, length 12; length of upper tooth-series 4·1.

I have much pleasure in naming this most beautiful and interesting little squirrel after its discoverer.

Sciurus Jentinki, sp. n.

General colour of upper surface yellowish grey, strongly suffused with orange on the head and along the centre of the back. Hairs dark slaty grey for four-fifths of their length, their tips yellow or orange. A spot in front of, and a distinct ring round, each eye white. Ears extremely short, rounded, their edges clothed with very short white or pale yellow hairs, contrasting markedly with the dark colour of the sides of the neck, where, just behind the ears, there is a distinct darker patch, owing to the suppression of the yellowish tips to the hairs, and consequent showing through of their slaty bases. Chin, chest, and belly pale yellowish white, the bases of the hairs grey. Tail-hairs comparatively short, only about 10 or 12 millim. in length, except just at the tip; broadly ringed with black and deep orange, their tips white.

Skull as in *S. tenuis*.

Incisors dark yellow above and below; premolars $\frac{2}{1}$; molars rather smaller and lighter than in *S. tenuis*.

Dimensions (skin) :—

Head and body 140 millim.; tail, without hairs 103, with hairs 136; hind foot, 32·5; ears, above crown, 4.

Skull: tip of nasals to bregma 25, greatest breadth 20; length of nasals 9·5; interorbital breadth 11·8; palate, length 16·6; length of upper tooth-series 6·4.

This species is most nearly allied to *S. tenuis*, Horsf., of which there is a large series in the Natural-History Museum. It differs, however, by its much paler orange-washed back, prominently white-rimmed ears, the dark patches behind the latter, and by its less bushy tail. It is noticeable also that the Bornean specimens of *S. tenuis* are much darker in colour, and therefore still less like *S. Jentinki* than are those from the

Malay peninsula, a fact which shows that the two species have no tendency to grade into one another.

I have named this species in honour of my friend Dr. F. A. Jentink, the Director of the Leyden Museum, to whose labours we are indebted for a large amount of our knowledge of the Mammals inhabiting the East-Indian archipelago, and especially of the Sciuridæ.

Of other squirrels *Sciurus Diardi*, Jent., and *S. Alstoni*, Anders., are both easily distinguishable from *S. Jentinki* by their much greater size, in addition to their detailed differences in coloration.

XIV.—*Descriptions of two new Species of Butterflies from South Afghanistan.* By H. Grose Smith.

Metaporia sorex.

Upperside. Both wings white. Anterior wings with the margins and nervures black; a broad black patch at the end and beyond the cell, the inner side of which curves towards the base, the outer side irregular, and the black extending partially along the first and second median nervules; an irregular submarginal black band from the costal margin to the third median nervule; between the band and the outer margin, which is broadly black, between the nervures, which are also broadly black, are seven white streaks—the first small, the second linear, the third and fourth larger than the first, the fifth nearly obsolete, the sixth the largest, and the seventh smaller than the sixth but larger than the fifth.

Posterior wings with the margins and ends of the nervures black; an obscurely-defined submarginal row of hastate spots and a small black spot at the end of the cell between the discoidal and first median nervule.

Underside. Anterior wings as above, with the costal margin and apex pale yellowish brown; the outer margin and ends of the nervures narrowly black.

Posterior wings yellowish brown, with black nervures and margins, and a well-defined submarginal band of hastate spots.

Expanse of wings 1¾ inch.

Hab. Gwashki, at an elevation of 8600 feet, 57 miles south-east of Quettah.

Near to *Larraldii* and *Bieti* of Oberthür, but not so black

and smaller. Captured by Mr. Dodgson, of the Royal Artillery.

In the collection of H. Grose Smith.

Melitæa Dodgsoni.

Male.—*Upperside.* both wings bright orange-brown, fringes white, spotted with black; a marginal black line and spots. Anterior wings with a submarginal row of black spots, the three lowest curving inwardly, inside of which, near the costa, are two black spots, followed by a central curved row of seven black spots, extending from the costal to near the inner margin; the third and fourth spots elongated, the seventh quadrate, the usual markings in the cell; below the cell near the base is a figure-of-8-marking, inside which is a hastate spot.

Posterior wings with a marginal and submarginal band of spots and a few markings near the base, which is dusky brown.

Underside. Anterior wings bright brown; apex and outer margin stramineous; fringe and spots as above, but the spots are smaller and the three lowest of the central row are nearly obsolete.

Posterior wings stramineous, with the usual two red bands, the row of spots between which approximate to the inner band; the spots on the lower side of the submarginal red band larger than on the upperside and lunular.

Female lighter than the male, and from the central band to the outer margin more or less mottled with pale fulvous.

Expanse of wings, male $1\frac{1}{2}$, female $1\frac{3}{4}$ inch.

Hab. Gwashki.

This butterfly belongs to the *Didyma* group.

In the collection of H. Grose Smith.

XV.—*Descriptions of some new Species of Land-Shells from Sumatra, Java, and Borneo.* By Edgar A. Smith.

Among the very valuable collections recently sent to this country by Mr. John Whitehead are a few land-shells which he obtained in the northern part of Borneo, consisting of the following species:—1, *Nanina regalis*, Benson; 2, *N. subconsul*, sp. n.; 3, *Trochomorpha Metcalfei*, Benson; 4, *T. planorbis*, Lesson; 5, *T. conicoides*, Metcalfe, var. *parva*; 6,

Leptopoma undatum, Metcalfe; 7, *L. sericatum*, Pfr.; 8, *L. Whiteheadi*, sp. n.; 9, *Opisthoporus pterocycloides*, Pfr.

The new species from Sumatra were partly obtained by Mr. H. O. Forbes and partly by Mr. Carl Bock, both well-known eastern travellers.

Helicarion Bocki.

Testa anguste perforata, viridi-cornea, nitida, suborbicularis; anfractus 4–5, convexiusculi, rapide accrescentes, striis spiralibus, tenuissimis incrementique lineis sculpti, ultimus superne rotunde angulatus, supra angulum concave excavatus spiraliterque subsulcatus, inferne striis concentricis minutissimis lineisque incrementi ornatus; sutura profunda, canaliculata; spira paulo elevata; apertura magna, parum obliqua; columella superne anguste reflexa.

Diam. maj. 22, min. 18; alt. 13 millim.

Hab. Sumatra. Collected by Mr. Carl Bock.

This species is readily distinguishable by the angulation of the body-whorl and the excavation above it. The last whorl is much impressed at the suture, forming a remarkably deep canaliculation. Besides the very fine spiral striæ, which everywhere cover the surface, the upperside of the body-whorl exhibits a number of spiral shallow sulci, which are visible to the naked eye. The lines of growth are well-marked, and at the suture are somewhat plicate.

Nanina hoodjongensis.

Testa profunde perforata, depresse globosa, mediocriter tenuis, viridi-flava, fasciis duabus nigrescenti-fuscis supra medium anfract. ultimi ornata, paulo nitida; anfractus 6, rapide accrescentes, undique subspiraliter confertim corrugati, convexi, ad suturam angustissime marginati, ultimus magnus, paulo inflatus, antice vix descendens, ad peripheriam porca indistincta instructus; apertura obliqua, elongato-lunata, albida superne bifasciata; peristoma tenue, marginibus leviter conniventibus, columellari superne breviter reflexo.

Diam. maj. 53, min. 42½; alt. 37 millim.

Hab. Hoodjong or Hoedjoeng, about 120 miles from the southern extremity of Sumatra, at an elevation of 2000 feet.

The single specimen of this fine species was collected at the above locality by Mr. H. O. Forbes. It is as inflated as *N. obliquata* of Reeve (Monog. Helix, Conch. Icon. f. 384), but has a more elevated conical spire; in other respects it is altogether different. The wrinkling of the surface is rather coarse, and on the underside of the body-whorl has a distinctly concentric direction. The slight ridge at the periphery falls

upon the lower band, which is of a somewhat darker tint than the upper one.

Nanina Rumphii, var.

A specimen collected by Mr. Carl Bock at Sydjoendjoeng differs somewhat from the normal form of this species. It is much more acutely keeled, and the curved lines of growth are rather more strongly granulated. It has not been previously recorded from Sumatra.

Nanina foveata of Pfeiffer is another variety of this species, being peculiar on account of the *more or less* undulate or plicate character of the upper surface. The locality "India" must be regarded in the sense in which it was formerly used, as applying to the East Indies and not to British India only.

Nanina subconsul.

Testa *N. consuli* simillima, superne tamen minus nitida; anfractibus paulo planioribus instructa, sculptura minutissime rugulosa superne ornata, inferne spiraliter microscopice striata.
Diam. maj. 19, min. 17; alt. $10\frac{1}{2}$ mill.

Hab. North Borneo (*John Whitehead*).

This species is very closely related to *N. consul*, and is only distinguished from that species by its duller upper surface, resulting from a different microscopic sculpture, and its slightly less convex whorls. The spiral striæ on the base are visible under an ordinary lens, but the minute rugulose lines of the upper surface are discernible only under a stronger magnifier.

Helix (*Trochomorpha*) *conicoides*, Metcalfe, var. *parva.*

Two specimens collected in Northern Borneo by Mr. John Whitehead are exceptionally small and depressed, and remarkable also on account of the basal margin of the peristome being slightly thickened, narrowly expanded, and reflexed, a feature which does not occur in ordinary examples. In colour, texture, and sculpture they offer no differences. Although consisting of seven whorls, the greatest diameter is only 11 millimetres.

Helix (*Geotrochus*) *bantamensis.*

Testa elate conica, perforata, mediocriter tenuis, griseo-alba; anfractus 7, tres superiores convexi, cæteri planiusculi, minute granulati, striisque incrementi sculpti, ad suturam carina mar-

ginati, ultimus ad peripheriam acute carinatus, infra subplanus, antice vix descendens; apertura obliqua, parva; peristoma albidum, margine superiore sinuato, leviter reflexo, basali latius expanso, superne umbilicum semiobtegente.

Diam. maj. 11, min. 10; alt. 12 mill.

Hab. Bantam, Java.

This species is as conical as *H. elata* (*vide* Reeve's Conch. Icon. fig. 1248), but the aperture is different, the basal margin being more curved. The apex of the spire is rather large and obtuse and the upper whorls are considerably more convex than the three last. The fine granulation of the surface is invisible to the naked eye. The acute keel of the body-whorl passes up the spire, giving a carinate appearance to the suture.

Leptopoma Whiteheadi.

Testa conica, umbilicata, mediocriter tenuis, purpurascenti- vel fuscescenti-cornea, maculis rufis sutura radiantibus picta, epidermide tenui sublamellata amicta; anfractus 6, convexi, carinis tenuibus 2–3 instructi, incrementi lineis striisque spiralibus inconspicuis sculpti, sutura subprofunda sejuncti, ultimus carinis ad 6 ornatus; apertura modice magna; peristoma anguste reflexum, bimarginatum.

Diam. maj. 12½, min. 10; alt. 12½ mill.

Hab. Northern Borneo.

This interesting species was collected by Mr. John Whitehead, with whose name I have associated it. It is peculiar on account of the epidermis, which upon the keels is produced into very short tufts. The operculum is very thin, yellowish, and consists of about eight whorls.

In the British Museum are two specimens also from Borneo which are smaller than those described, and differ also in having the peristome of a darker colour, and the brown markings radiate from the suture in an irregular zigzag manner.

Two other specimens from Bantam, in Java, also apparently belong to this species. They are still smaller and have the epidermis produced into short hairs upon the principal ridges.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

March 9, 1887.—Prof. J. W. Judd, F.R.S., President, in the Chair.

The following communications were read:—

1. "On *Chondrosteus acipenseroides*, Ag." By James W. Davis, Esq., F.G.S.

Sir P. Egerton described two species of *Chondrosteus* from the Lias of Lyme Regis, viz. *C. acipenseroides*, Ag., and *C. crassior*, Eg. The author describes an unusually fine specimen from the same locality, 44 inches long, the head, trunk, and tail being exceptionally complete, whilst a considerable portion of the elements of the vertebral column is preserved.

The head is proportionately large and deeper than the body of the fish. It has an almost circular outline with a diameter of about 9 inches, but the snout has been broken off during extraction. The cranium was protected by dermal bones or scutes. The anterior portion of the head, beneath the orbit, does not exhibit any traces of external defence, thus differing from existing Sturgeons. The frontals, postfrontals, parietals, mastoid, and some of the occipital plates are present: all these bones are united by sutures. The external surface of the dermal plates is coarsely striated or ridged; the ridges radiate for the most part from the centre towards the margin, the surface being covered by strips of ganoine. The orbit is oval. The base of the skull is formed by bones more completely ossified than in the existing Sturgeons: these are more extensive than in the Teleostean fishes, being the equivalents of the sphenoid bones of the latter.

Sir P. Egerton, in his description of the genus *Chondrosteus*, states that the elements of the scapular arch, which in recent Sturgeons are three in number, are reduced to two in the fossil genus by the coalescence of the scapula and the coracoid. The Author describes it as composed of a series of three bones, suprascapula, scapula, and coracoid (or clavicula). The last is united with the pectoral fin by two bones, apparently representing the radius and ulna of Owen (coracoid and scapula of Parker). The pectoral fin is large and comprised forty-two rays. The mandibles and maxillaries are large and well ossified, in this respect differing from existing species; there is no evidence of teeth. From the position of the respective maxillary and premaxillary bones in this specimen there can be no further doubt that the small bifurcated bone of *C. acipenseroides*, Ag., described as the maxillary bone, is really the premaxillary.

Bony neurapophyses are preserved in the anterior portion of the body. There is no trace of the vertebral column nor of ribs or hæmapophyses, except in the caudal fin, where hæmapophyses sup-

port the lower lobe. The neurapophyses extend from the occipital region of the skull to the base of the dorsal fin, 13 inches. In this length there are preserved thirty-five neurapophyses, representing the same number of vertebræ. The first ray of the dorsal fin is inserted above the thirtieth vertebra ; the total number of vertebræ in the spinal column would be from eighty to eighty-five. The caudal fin is very large and was a powerful organ of propulsion ; its upper lobe, as in the recent Sturgeon, is the longer of the two.

The specimen is nearly twice the length of those described by Egerton, and the Author indicated the differences in some detail. The division of the scapular arch into three parts, the suprascapula, the scapula, and the coracoid, appears to be undoubted, whilst in the specimens previously described the scapula and coracoid are said to be united. The two latter ossifications of the shoulder-girdle are separate in the existing Sturgeons, and in the Ganoid fishes this is also generally the case.

The Author then referred to the opinion expressed by Sir P. Egerton as to the homology of the cranial plates of fossil Sturgeons when compared with recent ones and also with Teleosteans, and to the confirmation of these views by Prof. Parker, who concludes that, although the Sturgeons cannot be said to occupy an intermediate position directly between the Selachians and the Bony Ganoids, yet on the whole that is their position.

Lastly, the Author states his belief that there is no specific difference between *C. acipenseroides*, Agassiz, and *C. crassior*, Egerton.

2. "On *Aristosuchus pusillus*, Ow., being further Notes on the Fossils described by Sir R. Owen as *Poikilopleuron pusillus*, Ow." By Prof. H. G. Seeley, F.R.S., F.G.S.

A Wealden fossil, comprising certain dorsal, sacral, and caudal vertebræ, with some associated bones belonging to the pubic region, formerly in the collection of the Rev. W. Darwin Fox, but now in the British Museum, was described by Sir R. Owen in 1876 as *Poikilopleuron pusillus*. In the present paper the author showed that the presence of a peculiarly shaped medullary cavity in certain vertebræ, a character upon the strength of which the bones were referred to *Poikilopleuron*, Desl., was not peculiar to that genus, but had been found in *Megalosaurus* and in other Dinosaurian reptiles, whilst the characters of the sacrum in "*Poikilopleuron pusillus*" differed from those of any Crocodilia. The species was clearly not a *Poikilopleuron*, but was apparently a Dinosaur belonging to an undescribed genus, for which the name of *Aristosuchus* was proposed.

The pubic bones were described and shown to resemble those noticed by Prof. Marsh in *Allosaurus*, *Ceratosaurus*, and *Cœlurus*, and the specimen itself has been referred by Prof. Marsh to the last-named genus. The genera named were, however, placed in distinct Dinosaurian suborders, and consequently it was evident that the pubic bones by themselves were insufficient for generic determination, whilst the dorsal vertebra of the Wealden fossil had the

texture usually found in Dinosauria, and not that peculiar to *Cœlurus*. The mode of attachment of the ribs was also different. The sacrum of *Cœlurus* was unknown, but was probably very different from that of *Aristosuchus*. In the latter the transverse processes or sacral ribs were given off from each individual vertebra, as in certain American forms, and not, as in *Iguanodon*, *Hylæosaurus*, *Megalosaurus*, &c., from the junction between two centrums.

The five sacral vertebræ of the fossil and their apophyses were then separately described in detail, and also an associated fragmentary caudal vertebra; and the conclusion was expressed that *Aristosuchus* was a Dinosaur nearly related to certain imperfectly described American types, such as *Allosaurus*.

3. "On *Patricosaurus merocratus*, Seeley, a Lizard from the Cambridge Greensand, preserved in the Woodwardian Museum of the University of Cambridge." By Prof. H. G. Seeley, F.R.S., F.G.S.

No Lacertilian has hitherto been described from the Cambridge Greensand. The only remains of Lizards known to the author as having been derived from that bed consisted of the two bones now described, the proximal end of a femur, and a sacral vertebra with the processes broken away. The former exceeded in size the corresponding bone of the largest living Monitor, and differed from the femora in all recent Lizards in so many respects as to indicate subordinal distinction. The vertebra was not found with the femur, and may have belonged to a different species; but there being nothing in the characteristics of the two bones inconsistent with their having belonged to one specific type, both were fully described as types of a new genus and species.

4. "On *Heterosuchus valdensis*, Seeley, a procœlian Crocodile from the Hastings Sands of Hastings." By Prof. H. G. Seeley, F.R.S., F.G.S.

An ironstone nodule from the Hastings Sands was acquired by the British Museum from Dr. Mantell's collection. The specimen measured 10 centimetres by 6, and displayed on its water-worn surface several procœlian vertebræ of a small Crocodilian, together with some other bones, perhaps belonging to a different reptile. These other bones appeared to comprise portions of a skull with peculiarities not hitherto recognized in procœlian Crocodiles, and a pubis and ischium exhibiting distinct Lacertilian characters, and of comparatively very small size, but still situated in proximity to the sacral vertebræ.

The vertebræ were described in detail in the paper, and referred to a new genus and species. They included one late cervical vertebra, eight dorsal, and two which might be considered as sacral. All appeared to be mature, and were more completely ossified than the same bones in living Crocodiles. The body of each centrum was

compressed laterally, the neural arch comparatively depressed and thrown out laterally above by the inferior V-shaped approximation of the side of the centrum. Several other peculiarities were also pointed out.

The paper concluded with notes on other vertebræ of similar character from Tilgate and Brook, and attention was called to a Crocodilian cervical vertebra with the procœlian cup from the Purbeck beds.

5. "On a Sacrum, apparently indicating a new type of Bird (*Ornithodesmus cluniculus*, Seeley), from the Wealden of Brook." By Prof. H. G. Seeley, F.R.S., F.G.S.

After some remarks on the characters of the sacrum in Birds, Ornithosauria, and Dinosauria, the author proceeded to describe a sacrum composed of six vertebræ in the Fox collection, now at the British Museum, and then to compare the fossil with the corresponding bones of the three groups named. The resemblance to the Dinosaurian and Ornithosaurian sacral vertebræ was less than those which connected the fossil with birds. From the latter it was distinguished by the smaller number of vertebræ in the sacrum, the absence of sacral recesses for the lobes of the kidneys, and the form of the articular face of the first sacral vertebra. But the small number of sacral vertebræ in *Archæopteryx*, the want of renal recesses in *Ichthyornis*, and the characters of the articulation in the Solan Goose showed that these differences were not essential; and the author concluded that the fossil belonged to a true bird, but that it formed a link with lower forms, and approximated more to Dinosaurs than did any other Avian type hitherto described.

May 11, 1887.—Prof. J. W. Judd, F.R.S., President, in the Chair.

The following communications were read:—

1. "Further Observations on *Hyperodapedon Gordoni*." By Prof. T. H. Huxley, LL.D., F.R.S., F.G.S.

The Author briefly noticed the circumstances under which he first described the occurrence of Lacertilian and Crocodilian fossils in the Elgin Sandstones, and the confirmation which his views as to the Mesozoic age of these remains had received from the discovery of *Hyperodapedon* in English Triassic rocks and in India. The original type of *Hyperodapedon Gordoni* from Elgin was, however, in bad condition, and the receipt at the British Museum of a second much better preserved skeleton, found in the Lossiemouth quarries of the same neighbourhood, had enabled him to add considerably to the known characters of the genus, and to compare it more thoroughly both with the recent *Sphenodon* (or *Hatteria*) of New Zealand and with the Triassic *Rhynchosaurus articeps*, several specimens of which are in the British Museum palæontological collection.

The recently discovered *Hyperodapedon*-skeleton was of nearly the same size as that formerly described, and must have belonged to an individual about 6 or 7 feet in length. The specimen was exposed by the splitting of a large block of sandstone, and comprised the skull, the vertebral column as far as the root of the tail, all the bones of the left and of part of the right fore limb, and those of the right hind limb, the whole almost in their original relations.

The bones were described in order and compared with those of *Sphenodon*, the most important differences in *Hyperodapedon* being the following :—

1. The centra of the presacral vertebræ are ossified throughout and more or less opisthocœlous, especially in the cervical region.
2. The anterior cervical vertebræ have long and strong ribs.
3. The external nares are not separated by bone.
4. Conjoined premaxillary bones form a long, conical, curved, pointed rostrum, which is received between the rostral processes of the mandible. All these were devoid of teeth and probably sheathed in horn.
5. The palatal area is very narrow in front and wide behind, with strongly curved lateral boundaries.
6. The posterior maxillary and palatal teeth are multiserial.
7. The rami of the mandible are united in a long symphysis, behind which they diverge widely, and the dentigerous edges are strongly concave upwards as well as outwards.
8. The mandibular teeth in front are set into a close, apparently continuous palisade, and become distinct and conical only at the posterior end of the series.
9. The fore foot is remarkably short and stout, with metacarpals of equal length.

The relations of *Rhynchosaurus* to *Hyperodapedon* and *Sphenodon* were then dealt with, the first-named being shown to occupy in some respects an intermediate place between the two others. The skull of *Rhynchosaurus* resembles that of *Hyperodapedon* in its single anterior nasal aperture, its premaxillary and mandibular rostral processes, and in having more than one series of palatal teeth ; but in general form and in the shape of the maxillæ, palatal bones, and rami of the mandible it departs far less from *Sphenodon* than *Hyperodapedon* does. Some comparisons of the limb-bones were also made.

The three genera mentioned were shown to form a particular group, which, however, had no claim to ordinal distinction, and appeared to form a family, Sphenodontidæ, of the Lacertilia, comprising two subfamilies, Rhynchosaurinæ (including *Rhynchosaurus* and *Hyperodapedon*) and Sphenodontinæ.

The fact that in this Lacertilian group the highest known degree of specialization, as shown in *Hyperodapedon*, was attained as early as the Triassic epoch, showed that in Permian times, or earlier, Lacertilia existed which differed less from *Sphenodon* than either of

the Rhynchosaurinæ did. Not only was the Lacertilian type of organization clearly defined in the Triassic epoch, but it attained a degree of specialization equal to that exhibited by any modern lizard.

2. "On Tertiary Cyclostomatous Bryozoa from New Zealand." By Arthur W. Waters, Esq., F.G.S.

The Cyclostomata noticed in this paper were from the same collections as the Chilostomata described in the last volume of the Quarterly Journal, and this part was kept back a short time, in the hope that the publication of the Report of the 'Challenger' expedition might throw some light upon this unsatisfactory suborder; but the results are very disappointing in this respect, as only thirty-three species are recorded, and these are for the most part well known and common ones.

It was proposed to subdivide the Cyclostomata into two sections, namely:—1, those in which the surface of the zoarium is to a considerable extent formed of the lateral walls of the zoœcia, as *Entalophora* &c.; and 2, those in which the zoœcia or cancelli open for the most part at right angles to the axis, or surface of the zoarium, or subcolony, of which *Heteropora* and *Lichenopora* are typical.

The Author recorded the preservation of the extremely delicate and fragile rays or "hair-like teeth" in the interior of the fossil *Entalophora intricaria*.

Out of the twenty-eight species or varieties eighteen are known living, and this part of the collection agrees with the former in indicating that it is comparatively recent. The number of these fossil Bryozoa is now brought up to 106. The new species described by the Author were:—*Entalophora wanganuiensis*, *Tubulipora tubipora*, *Lichenopora wanganuiensis*, *Reptocavea aspera*, *Heteropora napierensis*, and *Crassohornera waipukurensis*; and he also noted a new variety, *perangusta*, of *Diastopora sarniensis*.

May 25, 1887.—Prof. J. W. Judd, F.R.S., President, in the Chair.

The following communications were read:—

1. "On the Remains of Fishes from the Keuper of Warwick and Nottingham." By E. T. Newton, Esq., F.G.S.; with Notes on their Mode of Occurrence by the Rev. P. B. Brodie, M.A., F.G.S., and E. Wilson, Esq., F.G.S.

This paper gave an account of two series of fossil fishes which have been discovered in British Triassic strata. The specimens are very fragmentary, but the rarity of Ganoid fish-remains in the English Trias lends considerable interest to these discoveries. The first series noticed were obtained by the Rev. P. B. Brodie in the Upper Keuper of Shrewley, and consist of some half-dozen portions of fish, all small and much broken. The characters of the scales and

the positions of the fins, together with as much of the form as can be made out, point to their belonging to the genus *Semionotus*. The second series were obtained by Mr. E. Wilson, F.G.S., of the Bristol Museum, from Keuper Beds near Nottingham. A large number of specimens were in this case collected; but all of them are too much broken and crushed out of shape to allow anything very definite to be said about them. Some of these also appear to be *Semionotus*; they agree in size, as well as in some other particulars, with the Shrewley fishes, and may perhaps belong to the same species; but others, on account of their strongly heterocercal tail and ornamented scales, seem to belong to the Palæoniscidæ. The presence of a third form among these Nottingham fishes is indicated by masses of larger scales. The Rev. P. B. Brodie and Mr. Edw. Wilson each appended notes on the Triassic Beds from which the fishes were obtained.

2. "Notes on some Carboniferous Species of *Murchisonia* in our Public Museums." By Miss Jane Donald. (Communicated by J. G. Goodchild, Esq., F.G.S.)

The paper gave a history of the genus *Murchisonia*, an account of the relations between it and *Pleurotomaria*, and of the resemblances to it afforded by certain recently discovered species of *Turritella*. The synonymy and a new description of the genus followed, and then of the species *M. angulata*, *M. kendalensis*, *M. Verneuilliana*, and four forms, for which new names were proposed, were described and discussed, with notes on the localities where each had been found and the museums in which the specimens described were preserved The new species were named:—*M. pyramidata*, *zonata*, *sphærulata*, and *tenuissima*.

June 8, 1887.—Prof. J. W. Judd, F.R.S., President, in the Chair.

The following communication was read:—

"A Revision of the Echinoidea from the Australian Tertiaries." By Prof. P. Martin Duncan, M.B., F.R.S., F.G.S.

After calling attention to a previous paper by himself published in the Society's Journal for 1877, and to additions to the fauna made by Prof. R. Tate and Prof. M'Coy, the author proceeded to give notes on the characters, relations, and nomenclature of the following 29 species of Echinoidea:—

Cidaris (Leiocidaris) australiæ.
C. (Leiocidaris), sp.
Goniocidaris, sp., spines.
Salenia tertiaria.
Psammechinus Woodsi.
Orthologhus lineatus.
Paradoxechinus nodus.
Clypeaster folium, var. elongata.
C. gippslandicus.
C. (Monostychia) australis.
C. (Monostychia) Loveni.
Echinobrissus australiæ.
Catopygus elegans.
Pygorhynchus Vassali.

Echinolampas ovulum.
Holaster australiæ.
H. difficilis (Rhynchopygus dysasteroides).
Micraster brevistella.
Maretia anomala.
Megalaster compressus.
Pericosmus gigas.
Pericosmus Nelsoni.
P. compressus.
Lovenia Forbesi.
Euspatangus rotundus.
E. Laubei.
E. murrayensis.
E. Wrightii.
Schizaster ventricosus.

A few notes were added on the relations between this fauna and that now inhabiting the Australian seas, also on the connexions with the Tertiary Echinoidea of New Zealand, Sind, &c.

June 23, 1887.—Prof. J. W. Judd, F.R.S., President, in the Chair.

The following communications were read:—

1. "Note on some Dinosaurian Remains in the Collection of A. Leeds, Esq.—Part I. *Ornithopsis Leedsii*. Part II. *Omosaurus*, sp." By J. W. Hulke, Esq., F.R.S., F.G.S.

Part I. *Ornithopsis Leedsii*, nov. sp., from the Kimmeridge Clay of Northamptonshire.

The Author described a pelvis, vertebræ, and costæ referable to this genus, of a stature far surpassing that represented by the pelvis in the Fox Collection from the Isle-of-Wight Wealden, which he brought under the notice of the Society a few years since. The ilium has a very long preacetabular process. A rib is three times as large as the largest rib of an elephant of average stature. The trunk-vertebræ show the characteristic large chamber opening in the side of the centrum, under the platform supporting the neurapophyses. There is no post-pubis. The pubis and ischium diverge; their close resemblance to those of *Ceteosaurus oxoniensis*, figured by J. Phillips in the 'Geology of Oxford,' is obvious when each figure is reversed, their true position being misrepresented in that author's diagram, a very excusable error.

Part II. described a sacrum, with ilia, vertebræ, a femur, &c. The neural arches of the sacral vertebræ are synostosed, and so form a continuous roof (simulating the vault of a cranium) of the dilatation of the neural canal, which enclosed the sacral swelling of the spinal cord. The transverse processes are long. The ilia offer a general resemblance to those of *Omosaurus armatus* (Owen), but differ from those of this species in the relatively greater length and narrowness of the preacetabular process. The similarity of construction of this sacrum to that of *Stegosaurus*, described by O. C. Marsh, and the very close resemblance of their ilia were noticed. The author considered that an extremely close affinity exists between these two genera, and is prepared to find that, upon the acquisition of more materials, their identity may even be established. For the present, he preferred to refer the Peterborough Dinosaur to *Omosaurus*, and proposed for its specific name *durobrivensis*, having reference to that of the old Roman settlement in that locality.

2. "Notes on some Polyzoa from the Lias." By Edwin A. Walford, Esq., F.G.S.

The Author briefly reviewed the work of Etheridge, Vine, and others in the tabulating of the British Liassic Polyzoa, and mentioned also the labours of Terquem and Piette, Dumortier, and others in the same direction in France and Germany. He directed attention to a species described by Prof. Tate from the Lias of May, Normandy, under the name *Spiropora liassica*, and described specimens in his own collection from a similar horizon in the Midlands, with which it had been confounded. The English forms have very varying modes of growth—sometimes foliaceous after the fashion of the *Diastopora* proper of Haime, at other times ramose and cylindrical, like *Entalophora*. The latter habit, together with the long, and often partly free, zoœcia, suggest the relationship of the species with the *Tubuliporæ*. The exceptional state of preservation of the specimen is such as to show the cells in a perfect condition, with solid circular calcareous closures within the orifice of the zoœcial tubes, a feature common to both the foliaceous and the cylindrical forms. The surface-pores are unusually well preserved, and appear to be similar to those of the recent Cyclostomatous Polyzoa. The name of *Tubulipora inconstans* was proposed for the species.

Mention was also made of other fragments of Polyzoa of doubtful relationship occurring in the same beds.

3. "Report on Palæo-botanical Investigations of the Tertiary Flora of Australia." By Dr. Constantin Baron von Ettingshausen, For.Corr.G.S.

Mr. Wilkinson, the Government Geologist of New South Wales, supplied the Author with the material for a memoir on the Tertiary flora of Australia, recently contributed to the Imperial Academy of Sciences at Vienna. He there describes and figures 128 species of fossil plants. These are distributed amongst 72 genera and 36 orders. The Cryptogamæ contain 2 species, the Gymnospermæ 12, the Monocotyledons 2, the Apetalæ 56, the Gymnopetalæ 11, and the Diapetalæ 40. Of the orders, the Proteaceæ contain 20 species, the Cupuliferæ 14, the Cruciferæ 11, the Myrtaceæ 10, the Laurinaceæ 7, the Leguminosæ 6, and the Moreæ, Apocynaceæ, and Celastrineæ 5 species each.

The following is a synopsis of the general conclusions derived from the study of the Tertiary flora of Australia :—

1. The geographical distribution of plants in Australia differed in many ways from the present one.

2. Types of plants of the Southern, as well as of the Northern hemisphere are associated together.

3. The flora-elements represented chiefly contain Phylones (ancestral types) which are also common to other Tertiary floras of the globe. The character of the Tertiary flora of Australia cannot therefore be considered essentially different from that of the latter.

4. The Australian Tertiary flora, in accordance with the preceding statements, is but a part of one and the same original flora upon which all living floras of the globe are founded.

5. The comparison of this original flora with the present floras of the globe shows that in Australia the differentiation of the Phylones reached its highest limit.

6. Many analogies to the Tertiary flora are nevertheless to be found in the living Australian flora.

4. "On some new Features in *Pelanechinus corallinus*." By T. T. Groom, Esq. (Communicated by Prof. T. M'Kenny Hughes, M.A., F.G.S.)

The discovery by the Author, in the Coral Rag at Calne, of an additional and well-preserved specimen of the Echinoderm originally described by Dr. Wright as a *Hemipedina*, but subsequently made the type of a new genus, *Pelanechinus*, by Mr. Walter Keeping, afforded an opportunity of adding considerably to the known characters of the type. The test proved to be flexible, as in the Echinothuridæ, a point already noted by Mr. Keeping.

A number of details as to the interambulacral and ambulacral areas, the imbricating peristomial plates, pedicellariæ, and teeth were given. Pedicellariæ did not appear to have been previously observed in fossils.

The genus appeared to occupy an intermediate position between the Echinothuridæ, Echinidæ, and Diadematidæ, and must form the type of a distinct subfamily, perhaps referable to the last named. A new description of the species was added.

MISCELLANEOUS.

On the Races of the Honey-Bee.

By the Rev. H. W. Lett, M.A., T.C.D.

The increase of bee-keeping, the spread of literature treating exclusively of the subject, and the attention paid by bee-keepers in Europe, America, Asia, and Africa to the improvement of the honey-bee (*Apis mellifica*) have demonstrated that there are at least ten distinct varieties of this insect which are kept in hives.

And though this has occurred within the last fifteen years, no notice seems to have been taken of the existence of these well-marked races of the domesticated insect in its bearing on the theory of evolution. That interesting chapter in the history of that teaching has not yet been written; indeed, the facts summarized below are only to be found scattered over the pages of many bee-publications, some of which are difficult of access. The present paper is offered as a contribution towards that part of the natural history of the honey-bee.

The following are the names and distinguishing features of each

of the races of honey-bees that are best known to the bee-keeping community :—

I. Black or Brown.—The ordinary hive- or honey-bee, called by way of distinction the black or brown, from being of almost one uniform brown-black colour, with slight indications of paler bands on the abdomen, and clothed with greyish-brown hairs. Till within the last fifteen years no other bee was known in North or West Europe *. This is also the bee which, after escaping, has made itself wild in the American and New-Zealand woods.

II. Italian Alp.—The Italian Alp bee, sometimes called Ligurian, is indigenous to the mountainous district that lies in the north of Italy round about the Lakes Maggiore and Como. It is of a light orange-yellow colour, with two orange-red bands on the abdomen, and is longer and more slender than the black. They are better honey-gatherers, more hardy and prolific, and very courageous in defending their own hives, even from the ravages of the wax moth.

III. Cyprian.—The Cyprians are natives of Cyprus and part of Turkey in Asia. They are yellow, quite slender, wasp-like, and smaller than Italians. They always have a yellow shield-mark on the back between the wings. They are strong, excellent honey-gatherers, winter better than any other race, and are proof against being robbed by other bees. But they are easily excited and most revengeful stingers.

IV. Syrian.—The Syrian bees are found on that part of Asiatic Turkey which lies north of Mount Carmel. They are of the same size, qualities, and temper as the Cyprians, from which they differ in showing less yellow and being on the whole of a greyer colour over their whole bodies. They are quite distinct from the next.

V. Holy Land.—The Holy-Land, or, as the natives call them, the Holy Bees, are found in Palestine, south of Mount Carmel. They are marked like the Cyprians; but their hair is so light in colour that they appear to be beautifully striped. Their size is smaller than Italians, but larger than Cyprians. They are very active and far-flying, most wonderful cell-builders, and get honey from red clover; but they are ready to sting, become furious at the least smoke, and run off their combs when one is lifted from the hive.

VI. Tunisian.—Tunis, on the north of Africa, has a peculiar race of bees. They are the same in size as the Cyprian and Syrian, but their colour is dark brown—even darker than the common black or brown. They are active workers, keep on the combs when being handled, and bear smoke better than other eastern races; but they are liable to attack a person coming near them, even though not interfered with.

VII. Carniolian.—The Carniolian bees are natives of Carniolia, in South Austria. They are longer and thicker than the black or brown, being the largest domesticated European bee. The colour

* [This is hardly correct; the Italian Bee was known in Germany more than thirty years ago, when Siebold wrote his 'Wahre Parthenogenesis.'—Eds.]

is a rich dark brown, nearly black, while each ring of the abdomen is clearly marked by whitish-grey hairs, giving it a silvery look. They are equal to Italians in honey-gathering, fecundity, and hardiness, while they are of a most remarkably gentle disposition, never attacking the manipulator except when treated with improper roughness.

VIII. Hungarian.—The bees peculiar to Hungary are the size of, but far blacker than, the common browns. They are very fair honey-gatherers and as gentle as Italians; but their propensity to swarm renders them unprofitable.

IX. Egyptian.—The Egyptian bees are like Syrians in size, but quite yellow, like the Italians. They abound, both wild and in domestication, along the valley of the Nile, and while famed for good honey-gathering qualities, are, without exception, the most ferocious bees known outside of India.

X. South African.—There is an excellent race of bees, both wild and hived, in the Cape Colony, which it is to be hoped will soon be introduced to British bee-keepers. They are the size and colour of Italians, but greyer, while they are more tractable and at the same time very prolific and of most remarkable working-powers; where honey is to be gathered they keep at it early and late, and often even by moonlight.

Whilst all these races breed freely when crossed with each other, so that they cannot be regarded as separate species, they all differ in certain particulars, the most striking of which are noted above. The differences are no doubt the result of their being influenced by climatic surroundings, as well as, in some districts, of a long course of too close breeding.

Studying these ten varieties with the aid of a map of the world it appears that the nearer India is approached so much fiercer is the temper of the bees found to be. The question then might arise, Was this the condition of the first original bee, and have her descendants, as they migrated into colder climes, lost some of that ferocity which renders the Indian bee the terror to all travellers through the woods of that continent?

A point which opens a wide field of study is the colour of several races, and what developed it, and how far it is to be taken as an index of common descent; thus dark-coloured races are found in north-west Europe, Hungary, Carniolia, and Tunis, where they are wide apart from each other.

American bee-keepers have set before them the project of breeding bees by a judicious selection of queens and drones, with what they consider these six indispensable qualifications in bees kept for profit:—1. Hardy; able to bear bad winters without too great dwindling. 2. Good breeders; the queens laying in abundance, early in spring and late in autumn. 3. Gentle and quiet; not attacking mankind without provocation, and allowing themselves to be examined on a bar-frame comb when lifted from the hive. 4. Good honey-gatherers; working on the flowers from sunrise to sunset. 5. Strong and active; flying long distances to pasturage,

and vigorously defending their stores. 6. Long-tongued; being able to get honey from many flowers which defy most bees.

And so far intelligent bee-masters have been partially successful; indeed, there is every reason to expect that the honey-bee of the future will be as different from, and as much more valuable than, "the little busy bee" of the past as an English shorthorn excels an Irish brindled cow.

It is to be hoped that before the modern bee-breeders have obliterated the old distinct varieties those who have the opportunities will make careful coloured drawings, measurements of queens, drones, and workers, and further observations of all their peculiarities. It will be too late to attend to this branch of natural history when *Apis americana*, as we are told the new and improved bee of the "good time coming" is to be called, has taken possession of the hives of the world.—*Proc. Belfast Nat. Field Club*, ser. 2, vol. ii. pt. 6, p. 451.

On the Organization of Chætopterus. By M. Joyeux-Laffuie.

Chætopterus is one of the commonest Annelids on the coast of Calvados, where it lives abundantly below the level of the lowest tides; but considerable quantities are thrown up by the waves during strong gales, and it may be obtained by the dredge. The specimens observed by the author are referred by him to *Chætopterus Valencinii*, Quatref., notwithstanding some differences, and especially the number of segments in the inferior region, which was 30–35, instead of 15 as described.

On the median posterior * line of the superior region there is a furrow running from the posterior margin of the buccal funnel to the base of the two dorsal rami of the first pair of feet of the middle region. Here it bifurcates, and is continued in the form of two deep grooves situated in the thickness of the two great wing-like rami. These grooves traverse the rami from the base to the extremity, and are lined with an epithelium with long vibratile cilia.

The *Chætopterus* in its tube presents its two great rami bent upwards and backwards, with the two extremities in contact in the median line. The extremities of the two grooves are also in contact, so that there is a passage from one to the other, and their function is to guide to the buccal funnel the alimentary particles conveyed by the current which traverses the tube, and is caused by the paletiform rami of the three last segments of the region. This is easily determined by the addition of some coloured powder, when the particles are seen to collect in the grooves into small masses, which pass towards the buccal furrow. The author compares this function of the grooves to that of the endostyle of the Ascidia.

The segmental organs are remarkably developed in *Chætopterus*.

* The animal is supposed to be placed mouth upwards.

The median and inferior regions alone present segmental organs in pairs in each segment; the superior region never possesses any. Contrary to opinion, these organs are not contained in a single segment; they always commence in one segment and terminate in the following one; so that the first segment of the median region only contains portions of two segmental organs. Each segmental organ is formed by an internal orifice surrounded by a half-vestibule, and an excretory tube, which is continued into a spacious sac, and this opens externally through a short duct.

Each segment is separated from the following one by a diaphragm. Near the line formed by the union of this diaphragm with the integument is situated, on each side, the vestibule of the segmental organ. Its form resembles that of the sigmoid valves of the heart, and its inner surface is uniformly lined with vibratile cilia. The excretory tube follows the vestibule, and is entirely contained in the following segment; it is easily distinguished, even in the living animal, by its brownish colour. It is attached to the postero-internal surface of the large ventral muscle of the same side, and travels in a more or less curved direction in the different segments. At the level of the pedal ramus it widens considerably to form the dilated sac which follows it. This sac almost completely fills the cavity situated in the base of the dorsal ramus and opens externally by a short duct, having its external orifice upon the lower surface of the ramus. The inner walls of the whole segmental organ possess an epithelium with highly developed vibratile cilia, causing a current from within outwards.

The tissue of the walls of the segmental organ is composed of elements resembling those of the organ of Bojanus in the Mollusca. When separated these cells present a spherical form; they contain a large nucleus presenting one or more concretions, which may increase in volume, unite and form a calculus, almost entirely filling the cell. These calculi are often found free in the cavity of the organ, and it is to these concretions that its general brownish colour is due.

The sexes are separate; the testes and ovaries are nearly of the same form and position. They are mesenteroid cushions placed in pairs in each of the segments and attached to the upper surface of the partitions. Each testis or ovary has the form of a crescent, with the concavity turned towards the digestive tube. In both cases the cushion presents a great number of convolutions, united with the diaphragm by a very small mesentery, and never presenting an internal cavity. The products of reproduction are developed at the periphery and fall into the general cavity of the body, which, at the time of reproduction, is entirely filled with ova or spermatozoids. These products give a distinctive colouring to the two sexes —the males are dead-white, and the females have a slight rosy tint. —*Comptes Rendus*, July 11, 1887, p. 125.

Further Note on the Generic Name Muelleria.
By F. Jeffrey Bell.

I might have saved myself all the mental trouble to which I gave expression on p. 392 of the last volume of the 'Annals' had I remembered that Bronn, in a footnote to the explanation of pl. xlviii. of Band ii. of his 'Klassen und Ordnungen' (1860), says that *Mülleria* has been used five times before Jäger, and writes "*Actinopyga Lecanora*, nob. (*Mülleria Lecanora*, Jäg.)." *Jaegeria*, then, must be withdrawn, and the very excellent name of *Actinopyga* used in its place. I may advise the possessors of Mr. Scudder's 'Nomenclator Zoologicus' to add, in its alphabetical order,

"*Actinopyga*, Bronn, Hol. 1860."

On a Copepod (Cancerilla tubulata, *Dalyell*) *parasitic upon* Amphiura squamata, *Delle Chiaje*. By M. A. Giard.

In 1879 the author noticed the existence on the French coast of a curious Copepod parasitic upon *Amphiura squamata* *. A single specimen of the species had been observed and figured by Dalyell in 1851 ('Powers of the Creator,' vol. i. p. 223, pl. lxii. figs. 1–5) under the name of *Cancerilla tubulata*. At Wimereux the parasite is exceedingly rare; it is more abundant at Concarneau, where it was probably observed by P. J. van Beneden ('Commensaux et Parasites,' p. 138); but it is at Fécamp that it may be most conveniently studied. There the *Amphiura* is very common in the small pools with Corallines, and about one in every ten is infested by the parasite. The female *Cancerilla* is generally attached to the oral surface of the disk at the base of one of the arms, with its head turned towards the mouth of its host. The body of the parasite and its two ovigerous sacs are usually about the same size and arranged in a triangle, which is easily seen by the naked eye.

The cephalothorax is widened transversely and in form resembles the carapace of the common crab, whence the name of *Cancerilla*. It has a membranous lateral margin bearing stiff hairs. The first pair of antennæ are short, seven-jointed, with joints one and two larger and closely soldered together. They bear numerous hairs, especially on the outer side. The antennæ of the second pair are rather long and converted into prehensile organs, terminated by a strong hook. The mandibles are reduced to a styloid appendage with a tuft of very fine hairs at the extremity. The maxillæ have a wide base bearing three strong divergent points, striated transversely at the end. The two pairs of foot-jaws are robust and organized for prehension. The first pair of thoracic feet is biramose;

* Journ. Anat. et Physiol. t. xv. p. 452, note 1.

the outer branch, which is wide and furnished on its upper margin with six spinous hairs, has in its centre a large bilobed gland; the inner branch is very narrow, and terminates in two stiff hairs. The other thoracic feet (two to five) are rudimentary and gradually diminish; the genital segment is rather wide, while the three following abdominal segments are very narrow; the *furca* bears upon each of its branches one long and four smaller setæ.

The male, which is much rarer than the female, is smaller and of a narrower form, resembling that of *Cyclops*. The first and second pairs of thoracic feet chiefly furnish the differential sexual characters. The inner branch of the first biramose foot is wider than in the female and furnished with seven hairs on its free margin; the second pair are strongly developed and terminate in two long branches, of which the outer one is fringed with eleven setæ (one terminal and five on each margin), while the inner one has only eight setæ upon its inner margin. The other thoracic feet are rudimentary, as in the female; the genital segment bears a sixth pair of aborted feet, which would seem to confirm Della Valle's opinion that this segment is thoracic. Claus regards it as the first abdominal segment.

Oviposition takes place from the beginning of May to the end of September; the young attach themselves at the extremities of the arms of the Ophiuran, and approach the disk as they grow. Two or three egg-bearing females are sometimes found on the same *Amphiura*. After hatching the empty sacs adhere for a time to the abdomen of the female.

The ova are of a fine ashy-green colour. Segmentation is complete and unequal; there is epibolism and formation of the mesoderm by two primitive mesodermic cells, which originate from the endoderm at the point of contact of the latter with the first exodermic blastomeres. The nauplian embryo within the egg shows the rudiments of four pairs of limbs besides the characteristic appendages of the nauplius. The latter consist of a uniramous first pair, the basal joint of which bears two simple setæ and the terminal joint two barbed setæ, and of two biramose pairs. The upper branch of the latter is furnished with one simple and two barbed hairs; the lower branch bears five barbed hairs in the first pair and four in the second. Beneath each appendage there is on the margin of the carapace and on each side a glandular mass. The anal extremity is obtuse and furnished with two divergent hairs.

At Concarneau, and especially at Fécamp, the *Cancerilla* is frequently covered with a parasitic Rhizopod, which attaches itself to the carapace, especially at the anterior margin. The author names this *Podarcella cancerillæ*, gen. et sp. n., and describes it as a pedunculate Arcellian of which the peduncle adheres to the carapace of the Copepod by a small discoidal expansion. The peduncle is half as long again as the funnel-shaped cup; both are composed of an apparently chitinous substance; the walls of the cup are elastic, semitransparent, and irregularly notched at the margins, and within

it the amœboid body of the Rhizopods moves slowly. There are sometimes more than twenty of these Rhizopods upon the same *Cancerilla*.

In its general character *Cancerilla tubulata* approaches *Ascomyzon echinicola*, Norm., a parasite of *Echinus esculentus*, and *Asterocheres Lilljeborgii*, Boeck, a parasite of *Echinaster sanguinolentus*. The structure of its buccal armature is intermediate between that of the Pœcilostoma and Siphonostoma, and seems to show the artificiality of those two groups. The families Lichomolgidæ, *Kossm.* (Sapphirinidæ, *Brady*), Ascomyzontidæ, *Boeck* (Artotrogidæ, *Brady*), Bomolochidæ, *Claus*, and Ergasilidæ, *Claus*, should be united into a single group, for which the name Corycæidæ may be retained, as already proposed by Della Valle for the Lichomolgidæ. That author, however, goes too far when he unites under the genus *Lichomolgus* forms of Copepoda parasitic upon Cœlenterata, Gymnotoca, and Tunicata, for which, as for the types parasitic upon Echinodermata, distinct genera should be retained.—*Comptes Rendus*, April 25, 1877.

On some Points in the Anatomy of the Rhynchobdellean Hirudinea.

By M. Georges Dutilleul.

1. *Dorsal organ of the* Glossiphoniæ.—In a recent memoir M. Nusbaum, of Warsaw, indicates the presence, in the embryo of *Glossiphonia complanata*, Linn. (*G. sexoculata*, Bergmann), of a provisional dorsal organ which had escaped the notice of his predecessors. This is a pyriform cavity, limited externally by the raised ectodermic lamina and internally by the somatic mesoderm. The ectodermic cells bear long appendages which serve for the reciprocal attachment of the young animals. This organ soon disappears, according to the author, without leaving any traces. M. Nusbaum adds no comment to his description.

Having, in the course of my investigations, had the opportunity of checking the author's description and ascertaining its perfect correctness, the question arose, whether nothing of the same kind exists in the embryos of other species of the genus *Glossiphonia*, and particularly in that of *G. bioculata*, Bergm., which, in the adult state, bears a characteristic dorsal organ. My investigations of this species enabled me to ascertain that its embryo presents, in the very place of the dorsal organ of the adult, a formation analogous to that described by M. Nusbaum in the embryo of *G. sexoculata*. The embryos of *G. marginata*, Müll., are also provided with this organ, which, in them as in *G. sexoculata*, is provisional. From these observations we may conclude that the provisional dorsal organ of Nusbaum in the species *sexoculata* and *marginata* represents the permanent dorsal organ of the species *bioculata*.

As regards the ultimate fate of this provisional organ I have several times been able to find traces of it in the adult animals.

Thus, in sections of the adult *G. sexoculata*, I have observed in its place a strongly pigmented depression of the integument.

The constitution of the dorsal organ of *G. bioculata*, which in reality is only a plate of chitine buried in a depression of the skin, leads to the rejection of the denominations "dorsal gland" (Moquin-Tandon), "yellowish-brown spot" (Budge), and "red spot" (Robin), which have been applied to this formation by the authors who have examined it. It seems preferable to designate it by the name of the *dorsal chitinous plate*.

2. *Male apparatus of* G. sexoculata.—The data which we possess as to the male apparatus of *G. sexoculata* did not enable us to bring this apparatus into the very homogeneous series of the other species of the genus. The most recent memoir on the subject (Robin, 1862) still shows it as formed on each side of a simple tube, bent into a U, terminating on the one hand in a free point in the anterior region of the body, and on the other at the male genital aperture, after having been dilated into a sac for the spermatophores. Very numerous fine dissections have enabled me to ascertain that the outer branch of the U-shaped tube, instead of terminating in a free point, becomes bent back and attenuated, runs backward parallel to the axis of the body, and receives on its outer side the short deferent ducts of the ten testes of the corresponding side. This description enables us to bring the male apparatus of *G. sexoculata* into the series of forms already described by F. Müller, Budge, &c.

3. *Skin and Respiration in the Rhynchobdellea.*—Hitherto it has been assumed that the respiration of the Hirudinea is cutaneous, without investigating what differentiations this function might induce in the integument which is its seat. *Branchellion* alone had attracted some attention. I have examined whether there are not, in the series of the Rhynchobdellea, some particular arrangements which would enable us to explain the origin of the branchiæ in the parasite of the Torpedo, and I have ascertained that, in the different genera, the integument presents curious adaptive modifications. The most interesting type in this respect is *Pontobdella*. In this genus, which is cylindrical (an isolated fact among the Hirudinea), the dermis is swelled into voluminous tubercles. The structure of these formations not having hitherto been noticed, it will be useful to indicate it here, especially as their anatomy exactly accounts for their physiology.

The tubercle is a dermal projection (not, as M. de Saint-Loup will have it, a mass of epithelial lamellæ) covered with epidermis and furnished with muscles of two kinds—retractors, parallel to the axis of the tubercle, and extensors, which are radial. Capillaries are abundant in them. The extent of the surface, the abundance of its vascularization, and the peculiar development of its musculature place this organ under conditions exceptionally favourable for hæmatosis, and render the tubercle a respiratory organ, already highly differentiated.

From this primitive arrangement, in which the tubercles are uniformly distributed over the whole periphery of the segment, are derived those of *Glossiphonia* and *Branchellion*. In the former case the less-developed tubercles are localized on the dorsal surface; in the second they are modified in their form and become marginal.—*Comptes Rendus*, July 11, 1887, p. 128.

Note on some Reptiles from Sumatra described by Bleeker in 1860.

By G. A. Boulenger.

Dr. Strauch has kindly drawn my attention to a paper by Bleeker, "Reptilien van Agam," Natuurk. Tijdschr. Nederl. Ind. xx. pp. 325–329 (1860), containing descriptions of new species, which was unfortunately overlooked by me whilst preparing the 'Catalogue of Lizards.' This omission is the more to be regretted as the actual types of the species described in that paper are preserved in the British Museum, where they were received in 1863. Dr. Günther, also overlooking Bleeker's contribution, and considering the names appended to the specimens as merely MS., redescribed in 1872 and 1873 the species which appeared new to him. The following is a list of Bleeker's species, with their identifications:—

1. *Calotes Luedekingii*, Blkr. = *Lophocalotes interruptus*, Gthr.

Should bear the name *Lophocalotes Luedekingii*.

2. *Lophyrus megalepis*, Blkr. = *Tiaris tuberculatus*, Gthr.

Should be called *Gonyocephalus megalepis*.

3. *Hemiphyllodactylus typus*, Blkr. = *Spathodactylus mutilatus*, Gthr.

4. *Gymnodactylus agamensis*, Blkr. = *G. marmoratus*, Kuhl.

5. *Chelomeles sumatrensis*, Blkr. = *C. sumatrensis*, Gthr.

6. *Typhlina leucurus*, Blkr. = *Dibamus novæ-guineæ*, D. & B., ♀ (specimen *h* of Cat. Liz. p. 435).

7. *Tropidolepisma macrurus*, Blkr. = *Mabuia multifasciata*, Kuhl, *pull.*

8. *Calamaria agamensis*, Blkr. = *C. Schlegeli*, D. & B.

CONTENTS OF NUMBER 116.—*Fifth Series.*

Page

VII. Bryozoa from New South Wales, North Australia, &c. By Arthur Wm. Waters. (Plate IV.) 81

VIII. On new Reptiles and Batrachians from North Borneo. By G. A. Boulenger 95

IX. Notes from the St. Andrews Marine Laboratory (under the Fishery Board for Scotland).—No. VII. By Prof. M'Intosh, M.D., LL.D., F.R.S., &c. 97

X. Some new Hypotrichous Infusoria from American Fresh Waters. By Alfred C. Stokes, M.D. (Plate III.) 104

XI. Descriptions of new Species of Heterocerous Lepidoptera (Pyralites) from the Solomon Islands. By Arthur G. Butler, F.L.S., F.Z.S., &c. 114

XII. Description of a new Species of *Nucleolites*, with Remarks on the Subdivisions of the Genus. By Prof. F. Jeffrey Bell, M.A., Sec. R.M.S. 125

XIII. Description of two new Squirrels from North Borneo. By Oldfield Thomas 127

XIV. Descriptions of two new Species of Butterflies from South Afghanistan. By H. Grose Smith 129

XV. Descriptions of some new Species of Land-Shells from Sumatra, Java, and Borneo. By Edgar A. Smith 130

PROCEEDINGS OF LEARNED SOCIETIES.

Geological Society ..... 134—143

MISCELLANEOUS.

On the Races of the Honey-Bee. By the Rev. H. W. Lett, M.A., T.C.D. 143

On the Organization of *Chætopterus*. By M. Joyeux-Laffuie 146

Further Note on the Generic Name *Muelleria*. By F. Jeffrey Bell 148

On a Copepod (*Cancerilla tubulata*, Dalyell) parasitic upon *Amphiura squamata*, Delle Chiaje. By M. A. Giard ..... *ib.*

On some Points in the Anatomy of the Rhynchobdellean Hirudinea. By M. Georges Dutilleul 150

Note on some Reptiles from Sumatra described by Bleeker in 1860. By G. A. Boulenger 152

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Diptera. By Baron C. R. VON OSTEN SACKEN. (Pp. 1–216, pls. i.–iii.)

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THE ANNALS

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MAGAZINE OF NATURAL HISTORY.

[FIFTH SERIES.]

No. 117. SEPTEMBER 1887.

XVI.—*The Sponge-fauna of Madras. A Report on a Collection of Sponges obtained in the Neighbourhood of Madras by Edgar Thurston, Esq.* By ARTHUR DENDY, B.Sc., F.L.S., Assistant in the Zoological Department of the British Museum.

[Plates IX.–XII.]

THE specimens upon the study of which this paper is based were collected in the neighbourhood of Madras by Edgar Thurston, Esq., Superintendent of the Government Central Museum, and forwarded by him to my colleague, Prof. F. J. Bell, to whom I am indebted for the opportunity of examining and describing them.

The collection is of exceptional interest, owing to the fact that it is the first which has been obtained from this particular locality. Indeed, our knowledge of the sponge-fauna of the entire Indian Ocean is extremely deficient. This deficiency is almost certainly due to want of investigation rather than to any actual scarcity of sponges. Mr. Ridley and I have already pointed out, in our Report on the Monaxonida collected by H.M.S. 'Challenger,' that "this little-known field will probably yield a rich harvest to whoever has the good luck to thoroughly investigate it;" and this statement is amply borne out by Mr. Thurston's researches.

The best-known locality for sponges in the Indian Ocean

is undoubtedly Ceylon; Bowerbank *, Gray †, and Carter ‡ have all written upon the sponge-fauna of this particular district, and the sponge-fauna of Madras, in so far as is evidenced by the material at my disposal, bears a striking resemblance to it. Thus, out of the ten determinable species from Madras, four, viz. *Halichondria panicea* (a cosmopolitan species), *Axinella Donnani*, *Hircinia clathrata*, and *Hircinia vallata*, have already been recorded from the neighbourhood of Ceylon.

There can be no doubt that the present collection was obtained in shallow or moderately shallow water, although there is no record of the depth. Species with a strong development of spongin in the skeleton-fibre predominate, as might have been safely predicted from the climatic conditions of the locality. It is remarkable that all the species, with a single exception, belong to the suborder Halichondrina or else to the Keratosa, which are undoubtedly direct descendants of the former group. The single exception is a new species of the cosmopolitan genus *Suberites*, which I have called *S. inconstans*, owing to its extraordinary variability in external appearance.

In addition to the species recorded below there are in the collection a number of Ectyonine and Homorrhaphid forms, which I have thought desirable to leave undetermined until a better supply of material is forthcoming. Unfortunately all the specimens have been dried, but I hope before long to receive a second instalment preserved in alcohol.

Suberites inconstans, n. sp. (Pls. IX., X.)

There are six specimens of this species in the collection. They present us with an extraordinary range of external form, and yet all agree so closely in the arrangement and in the shape and size of the spicules that it is impossible to distinguish more than one species. I have therefore decided to group all the specimens under three varieties :—(1) *Suberites inconstans*, var. *globosa*; (2) *Suberites inconstans*, var *mœandrina*; (3) *Suberites inconstans*, var. *digitata*.

* "Report on a Collection of Sponges found at Ceylon by E. W. Holdsworth, Esq.," Proc. Zool. Soc. 1873, p. 25.

† "Sponges from Ceylon," Ann. & Mag. Nat. Hist. ser. 4, vol. xii. p. 266. (This paper is only a brief criticism of Dr. Bowerbank's.)

‡ "Report on Specimens dredged up from the Gulf of Manaar," &c., Ann. & Mag. Nat. Hist. ser. 5, vol. vi. p. 35; "Supplementary Report on the Specimens dredged up from the Gulf of Manaar," &c., Ann. & Mag. Nat. Hist. ser. 5, vol. vii. p. 361.

Suberites inconstans, var. *globosa.* (Pl. IX. figs. 1, 1 *a*.)

Sponge (Pl. IX. fig. 1) massive, sessile, attached, irregularly spherical, averaging about 160 millim. in diameter. Surface uneven, but without digitate processes, very minutely hispid. Irregularly scattered over the surface are numerous large, more or less circular openings, which must be regarded as the oscula; these average in diameter about 4 millim. in one specimen, while in the other they are smaller. Colour light brownish orange. Texture hard and woody, incompressible; internally cavernous.

Skeleton very irregular, composed of dense masses of loosely aggregated tylostyli, without any defined fibres. At the surface the tylostyli are mostly arranged in brushes with their apices projecting outwards.

Spicules (Pl. IX. fig. 1*a*) large, stout, usually slightly curved tylostyli, with well-marked, somewhat elongated heads of the "enormi-spinulate" type and with gradually sharp-pointed apices. Size about 0·57 by 0·022 millim.

There are two specimens of this variety, agreeing fairly closely with one another in external form.

Suberites inconstans, var. *mæandrina.* (Pl. X.)

The single specimen (Pl. X. fig. 1) consists of a great, hemispherical, cake-like mass, attached by a very broad base to a mass of calcareous débris. Average diameter about 300 millim. The upper surface (Pl. X. fig. 1 *a*) is uneven, and is also furrowed by numerous, closely-placed, very deep, meandering grooves or elongated pits, each of which is about 2–3 millim. broad, and has slightly prominent margins. There are also usually numerous very small pits between the grooves. The general surface is again very minutely hispid. Colour light brownish orange. Texture hard, woody, and incompressible.

Skeleton and spicules as before, except that the spicules appear to be a trifle shorter.

The meandering pits on the surface, from which I have taken the name of this variety, are doubtless homologous with the circular pits on the surface of the last variety, from which we may imagine them to be derived by a process of lateral elongation. In cases like the present it is of course an open question as to what are to be considered the true oscula.

Suberites inconstans, var. *digitata.* (Pl. IX. fig. 2.)

There are three specimens which I refer to this variety. They differ considerably from one another in external appear-

ance, but all of them show a more or less strongly marked tendency to form digitate processes. All three resemble the preceding specimens in colour and texture, but in two of them the orange colour is more distinctly pronounced.

The specimen (Pl. IX. fig. 2) which I consider most typical of the variety consists of a number of upright, branching and anastomosing, cylindrical processes, springing from a very irregular, thin, basal lamina, which has overgrown a mass of calcareous débris. The finger-like processes are, at any rate usually, tubular, and sometimes there is an osculum at the summit. All the processes and their branches grow vertically upwards. The height of the entire specimen is about 155 millim., and the greatest breadth about the same, while the diameter of the finger-like processes averages about 17 millim. The surface of the sponge is fairly even, and, in addition to being very minutely hispid, is also minutely punctate, the punctation being most distinct on the lower, paler-coloured parts of the specimen. This punctate character is not confined to this specimen, nor even to this variety, but it appears to be a variable feature.

Of the two remaining specimens of the variety one has the digitate processes very broad and irregular, with a very uneven, corrugated surface; while in the other the digitate processes are almost obsolete.

The skeleton is much the same as in the preceding varieties, except that the fibres are generally more distinct, and, at any rate in the type of the variety, it is possible to distinguish between primary fibres running vertically to the surface and secondary ones crossing them more or less at right angles.

The spicules are of just about the same shape and size as in the two preceding varieties.

Perhaps the most nearly allied of previously described species is Nardo's *Suberites massa* *. This occurs in the canals of Venice, and is stated to reach the size of a human head; it is also of a bright orange colour. Thus it must closely resemble the massive varieties of the present species in external appearance; but it differs in the size and form of the spicules, which, in *Suberites massa*, as evidenced by one of Schmidt's preparations in the British Museum, are much longer and relatively very much slenderer than in *S. inconstans*. Another species which resembles *S. inconstans* in the great size to which it grows is Bowerbank's *Hymeniacidon* (= *Spirastrella*?) *pulvinatus* †, from near Belize. Bower-

* *Cf.* Schmidt, Spong. adriat. Meeres, p. 67.

† Proc. Zool. Soc. 1872, p. 126.

bank's species, however, grows to a far greater size and differs widely enough in the arrangement of the oscula on the upper surface and in the smaller size of the tylote spicules.

The most remarkable feature about *S. inconstans* is its extreme variability in external form; it thus affords a striking parallel to the cases of *Spinosella sororia* and *Pachychalina variabilis*, two common West-Indian Chalinine sponges, with which I have dealt at length elsewhere *.

Halichondria panicea, Johnston, var.

1842. *Halichondria panicea*, Johnston, British Sponges, p. 114.

I identify with this well-known and widely-distributed species a single massive specimen measuring about 100 millim. in average diameter, with a well-marked tendency to give off above short, digitate, tubular processes. Surface covered with small monticular prominences. Colour (dry) white below and light pink above. Texture very soft and crumbling.

Both the main and dermal skeletons form a very confused, irregular, and loosely put together reticulation of spicules, apparently with no spongin.

The spicules are the usual slightly curved, long, gradually sharp-pointed, fusiform oxea; they average about 0·7 by 0·014 millim. in size when full-grown, thus agreeing fairly well with those of the Kerguelen variety.

Mr. Carter † has already recorded a sponge which he calls "*Amorphina megalorhaphis*, n. sp.," from Ceylon, and he also remarks, in the same place: "This seems to be a variety of the common British species *Halichondria panicea*, chiefly differentiated by the size of its largest spicules, which is double that of the English one."

The synonymy and geographical distribution of the species will be found in the Report on the Monaxonida dredged by H.M.S. 'Challenger,' p. 2.

Tedania digitata, Schmidt, sp.

1862. *Reniera digitata*, Schmidt, Spong. adriat. Meeres, p. 75.

There is one fine specimen which is undoubtedly referable to this widely distributed species. It consists of a low-growing mass rising up into short, digitate, conical processes or large mamillæ, and has a very uneven, corrugated surface. In its present (dry) condition it is of a pale yellow colour tinged with pink, but a label with it states that the colour, when alive, was red.

The measurements of the spicules are as follows:—Smooth

* Proc. Zool. Soc. 1887.

† Ann. & Mag. Nat. Hist. ser. 5, vol. vii. p. 368.

styli, 0·245 by 0·0094 millim.; tylota (with minutely spined heads), 0·2 by 0·0048 millim. (thickness of shaft); oxeote rhaphides, 0·19 by 0·0025 millim.

The species has already been recorded from the Mediterranean, Atlantic, Antigua, Kurrachee, Australia, Mozambique, and the Amirante Islands; and for further details the reader is referred to Ridley's Report on the Zoological Collections of H.M.S. 'Alert' (1884), pp. 417, 607, and to Ridley and Dendy's Report on the Monaxonida dredged by H.M.S. 'Challenger,' p. 51.

Iotrochota baculifera, Ridley, var. *flabellata*.

1884. *Iotrochota baculifera*, Ridley, Zool. Coll. H.M.S. 'Alert,' Brit. Mus., p. 435.

There are in the collection two specimens which have given me a great deal of trouble in determining, and which I have finally decided to regard as belonging to a variety of Ridley's species *Iotrochota baculifera*, the types of which were obtained from Port Darwin, Australia.

Each specimen forms an irregularly shaped, flattened mass, and the larger of the two measures about 160 by 110 millim., and has an average thickness of about 5 millim. Both specimens are of a dark purple colour. The dermal membrane has in most parts been rubbed off, but the surface appears to have been smooth, although very uneven, in life.

The megasclera are (1) fairly stout, commonly somewhat curved styli, usually sharp-pointed, size about 0·176 by 0·0063 millim.; (2) straight tylota, occurring chiefly in the dermal membrane, as is usually the case with diactinal megasclera, size about 0·22 by 0·0048 millim. The microsclera are minute amphiastra ("birotulates") about 0·0126 millim. long.

This variety differs from the types as described by Ridley (1) in the flabellate instead of lobose habit, and (2) in the smaller size of all the spicules.

Axinella Donnani, Bowerbank, sp. (Pl. XI. fig. 1.)

1873. *Isodictya Donnani*, Bowerbank, Proc. Zool. Soc. 1873, p. 28, pl. vi. figs. 2–6.

This remarkable and well-characterized species was originally described and figured by Dr. Bowerbank fourteen years ago from a single dry specimen, and has not since been heard of. The type specimen was obtained from the Pearl-banks, Ceylon, by Mr. Holdsworth, who remarks: "The dark, thick, cup-shaped sponge with undulated margin is not un-

common on the large pearl-bank in from 6½ to 9 fathoms; and I have met with it once or twice on rough ground on other parts of the coast; it is usually attached to some bit of rock, and is always, when alive, of a uniform bright orange-colour. It turns black an hour or two after being taken out of the water. The largest specimen I have seen was about as large again as the one you have. The general shape and colour are always the same" *.

The species is undoubtedly referable to the genus *Axinella*, of which, in both form and arrangement of the spicules, it is a typical member. It is represented in the present collection by four specimens of a dark brownish colour, ranging in diameter from 55 to 130 millim., and in height from 42 to 130 millim. All are distinctly pedunculate and have the same general external appearance although varying widely in details of form. One specimen is almost a facsimile of that figured by Bowerbank and is, moreover, labelled "colour orange," which is a very satisfactory confirmation of Mr. Holdsworth's statement. A second specimen is also cup-shaped, but the wall of the cup, instead of simply undulating, is proliferated outwards into large, branching and anastomosing, vertical lamellæ.

The most remarkable variation in external form is, however, exhibited by a specimen which is not cup-shaped at all, but consists of a number of vertical lamellæ inclined at various angles to one another and attached to a stout peduncle. The surfaces of these lamellæ are furrowed towards the upper margin by numerous deep longitudinal grooves about 1·5 millim. broad, in which lie numerous minute oscula. In a few places only the grooves are very short and stellately arranged, these stellate grooves occurring lower down on the specimen than the longitudinal ones. I have thought it desirable to give an illustration of this remarkable form (Pl. XI. fig. 1).

As the species has already been pretty fully described, I need give no further details except with regard to the spicules. These are fairly stout, gradually sharp-pointed, usually curved styli, averaging about 0·315 by 0·0157 millim. in size. The small and slender styli ("acuates"), mentioned by Bowerbank, are scarce in my specimens; no doubt they are young forms of the larger spicules.

Phakellia Ridleyi, n. sp. (Pl. XI. figs. 2, 2 *a*.)

Sponge (Pl. XI. fig. 2) erect, flabellate, forming thin fronds. There are in the collection two specimens, measuring 80 millim.

* Proc. Zool. Soc. 1873, p. 29.

high by 85 millim. broad and about 3 millim. thick, and 95 millim. high by 67 millim. broad and about 3 millim. thick, respectively. Colour in the dry state light brick-red. Texture hard and fairly tough. Surface marked with longitudinal ridges and furrows; minutely hispid. The dermal membrane appears to have been almost entirely rubbed off. In the present condition of the specimens it is almost impossible to discover the arrangement of the pores and oscula; but there is no reason to doubt that they are arranged here as in other species of the genus, viz. the oscula on one surface and the pores on the other.

The skeleton is reticulate, with stouter, polyspiculous, longitudinal fibres. The crossing fibres are very irregularly developed and ill-defined. There is not very much spongin present.

The spicules are smooth, more or less curved styli (Pl. XI. fig. 2 *a*), well rounded off at the base, and gradually sharp-pointed at the apex. Size about 0·4 by 0·015 millim.

This is a pretty little species with a characteristic external appearance. I have great pleasure in dedicating it to my friend and late colleague Mr. S. O. Ridley, M.A., who has for many years held a distinguished position amongst spongologists. The species is remarkable on account of its small size, if we may be allowed to judge of this from only two specimens, and also on account of its red colour.

Raspailia fruticosa, n. sp. (Pl. XII. figs. 2, 2 *a*.)

Sponge (Pl. XII. fig. 2) erect, consisting of a bushily ramose mass of fairly stout, cylindrical branches placed upon a short peduncle. Most of the branches appear to have arisen by simple furcation of pre-existing ones; but some few are given off in the form of small secondary branches from older and stouter primary branches. The branches anastomose freely at points where they come in contact with one another; all of them tend vertically upwards and end in blunted apices. There are three specimens present; the largest measures 150 millim. in height and 120 in greatest breadth, while the diameter of the branches averages about 7 millim. Two of the three specimens are distinctly compressed in one plane. Colour (dry) dark brown. Texture rather hard and brittle. Surface very distinctly hispid and covered all over with numerous minute perforations, which appear to be the oscula.

The skeleton is distinctly reticulate; it consists in the first place of a more concentrated axial portion occupying the centre of each branch, from which primary fibres radiate upwards and outwards to the surface of the sponge. These radiating

primary fibres are connected with one another by short secondary fibres, which run from one to the other at right angles, and thus give rise to an irregular, rectangularly meshed network. The ends of the primary fibres project beyond the surface in the form of tufts of spicules, and amongst the shorter spicules composing these tufts there also project a number of very long and slender spicules; these reach a considerable distance beyond the surface, and thereby give it its characteristic hispid appearance. There is a considerable amount of amber-coloured spongin present, uniting the spicules into fibres; but the fibres are very ill-defined and irregular, the spicules in the primaries being arranged in a more or less Axinellid manner.

The spicules are of various forms, viz.:—(1) More or less curved, gradually sharp-pointed, fairly stout, smooth styli, averaging in size about 0·315 by 0·01 millim., but subject to considerable variation, especially in diameter; these make up the chief portion of the skeleton. (2) Very long and slender, very gradually sharp-pointed, slightly flexuous, smooth styli (Pl. XII. fig. 2 *a*); size about 0·8 by 0·007 millim.; occurring at the surface, projecting amongst the smaller spicules as described above. (3) Spined styli, with a few stout, sharp, strongly recurved spines. Sometimes there are three or four unusually large spines arranged like the teeth of a grapnel at the extreme apex. There appear to be very few or no spines at the base. These spicules are rather rare; they occur projecting obliquely outwards and forwards from the primary fibres, at or near the surface of the sponge. Size about 0·14 by 0·0095 millim. There occur also fairly numerous, long, slender rhaphides, probably incompletely developed styli.

The external appearance of this sponge is very characteristic, and it appears, judging from the three specimens present, to be very constant; the best idea of it will be obtained by reference to the figure.

Raspailia Thurstoni, n. sp.
(Pl. XII. figs. 1, 1 *a*, 1 *b*.)

Sponge (Pl. XII. fig. 1) erect, ramified dichotomously in one plane, pedunculate. Branches long and rather slender, tending vertically upwards, tapering slightly to rather obtuse apices. Height of the larger of the two specimens present 190 millim., breadth about 145 millim., diameter of branches about 4·5 millim. Surface granular, minutely punctate, not distinctly hispid as in the preceding species. Texture hard and tough. Colour (dry) pale yellowish brown; one specimen has a reddish tinge at the base.

The skeleton consists in the first place of an extremely dense and tough, slender, cylindrical axis, measuring in the branches about 0·6 millim. in diameter. This axis is composed of a solid mass of rather dark amber-coloured spongin, with numerous imbedded spicules. From it numerous primary fibres radiate upwards and outwards to the surface of the sponge, joined together at right angles by secondary fibres, so as to give rise to a very dense network with irregularly rectangular meshes. Both primary and secondary fibres contain a large proportion of spongin. The primary fibres terminate at the surface in dense, elongated tufts of spicules arranged in a typical Axinellid manner, amongst them being a very great number of the strongly spined styli. The very long, slender styli, projecting far beyond the surface and forming so characteristic a feature of *Raspailia fruticosa*, are not present, and it seems very probable that they are functionally replaced by the numerous spined styli, which, it must be remembered, are very rare in the preceding species.

Spicules:—(1) Smooth, very gradually sharp-pointed, more or less curved styli (Pl. XII. fig. 1 *b*), usually short and stout, measuring about 0·28 by 0·014 millim., but often longer and slenderer and sometimes shorter and stouter; in short, very variable in size: these spicules form the main mass of the skeleton. (2) The spined styli (Pl. XII. fig. 1 *a*); more or less curved, stout, and tapering gradually towards the apex. The spines are very stout and sharp-pointed and strongly recurved towards the base, which is usually quite smooth; commonly the spicule terminates in three or four large spines arranged around the projecting apex like the teeth of a grapnel, the apex itself being represented merely by a low rounded wart; or sometimes the spicule may terminate in a sharp-pointed apex with no spines. Size of spicule about 0·025 by 0·0094 millim. These spicules are very abundant in the position indicated above. In boiled-out preparations a few very much elongated, slender, smooth styli, like those occurring at the surface of *Raspailia fruticosa*, make their appearance; but I have not observed them *in situ*.

I have much pleasure in naming this species after Mr. Thurston, to whom I am indebted for the opportunity of studying and describing this valuable collection. It is interesting to find two species so nearly resembling one another in all essential characters, yet so totally distinct from one another, as *Raspailia fruticosa* and *Raspailia Thurstoni*, both coming from the same locality. They may be distinguished from one another immediately both by their external

appearance and by their spiculation, and although there are in the collection three specimens of the one species and two of the other, none of them show any transitional condition between the two species. It is also very interesting to observe how different spicules are utilized in the two species for the same function, viz. the protection of the surface.

Hircinia clathrata, Carter.

1881. *Hircinia clathrata*, Carter, Ann. & Mag. Nat. Hist. ser. 5, vol. vii. p. 366.

With this species I identify two dry, washed-out specimens of fair size. There can be no reasonable doubt as to the identification, for Mr. Carter's original specimen, which came from the Gulf of Manaar, is sufficiently well characterized to make it certain, although I have been unable to examine the type.

The species has hitherto been recorded by Carter from the Gulf of Manaar and from the Red Sea.

Hircinia vallata, n. sp.

Hircinia vallata, R. v. Lendenfeld, MS.

Sponge more or less semicircular in outline. Consisting of an erect, thick, flattened lamella, with a narrow, smoothly curved upper margin, along which the oscula are placed. Surface flat, like the surface of a wall, honeycombed by numerous shallow, rounded or polygonal depressions. Texture very coarse, rough and cavernous; there is an enormous quantity of foreign matter present, such as sand, sponge-spicules, &c. Colour brownish grey. The oscula are, as already stated, arranged along the upper margin of the sponge; they are the openings of wide exhalant canals, radiating upwards from deep down in the body of the sponge. In the single specimen from Madras there are also numerous much smaller round openings scattered over both flattened surfaces of the sponge; but it is not certain whether these are oscula or not; they do not occur in the Ceylon specimen, to be mentioned later on.

The single specimen from Madras measures 140 millim. in height by 290 millim. in width; it is 45 millim. thick in the centre of the base and 12 millim. thick in the centre of the upper margin. The oscula and the large exhalant canals leading up to them average about 4·5 millim. in diameter. The Ceylon specimen is of the same general form, but broader, thicker, and not quite so high.

The skeleton is excessively coarse, loose, and irregular; in many places it seems to consist only of a rough network of foreign bodies, including spicules of all shapes and sizes, cemented together by spongin, while sometimes longer or shorter stretches of pale-coloured fibre occur, containing no foreign bodies at all. The filaments are abundant, forming tangled masses.

There is in the collection of the British Museum a specimen from Ceylon, which I have already had occasion to refer to, and which belongs to the same species as the Madras specimen. It was collected by Mr. E. W. H. Holdsworth, and is labelled in Dr. Bowerbank's handwriting "*Stematumenia.*" It is obviously one of the two specimens referred to by him, in his "Report on a Collection of Sponges found at Ceylon by E. W. H. Holdsworth, Esq." *, under that name; but he appears to have considered these two specimens unworthy of description.

Dr. von Lendenfeld, in working over the British Museum collection of horny sponges for his forthcoming monograph of the group, has given the manuscript name "*Hircinia vallata*" to the species in question, a name to which I of course adhere.

Genus Hippospongia, Schulze.

There are in the collection two fair-sized specimens, evidently both belonging to the same species. They are massive and give off from the upper surface hollow digitate processes. One specimen, which has evidently been dredged in the living condition, has the skin still attached and shrunk on to the skeleton; this gives to the surface a uniform black colour. The other specimen is only a washed-out skeleton, and is of a dirty greyish-yellow colour. The primary lines of the skeleton are densely cored by foreign spicules, and the interspaces between them are filled with an angularly-meshed network of horny fibre, containing no foreign bodies and averaging in diameter about 0·007 millim.

In the almost hopeless state of confusion at present existing with regard to the classification and nomenclature of the horny sponges, I shall not attempt to attach a definite specific name to these two specimens. Suffice it to say that they closely resemble von Lendenfeld's *Euspongia canaliculata* †,

* Proc. Zool. Soc. 1873, p. 25.

† "A Monograph of the Australian Sponges," Proc. Linn. Soc. New South Wales, vol. x. p. 502.

but differ in the absence of a distinct dermal reticulation of foreign bodies, such as is described and figured for that species, although irregularly scattered foreign bodies are fairly abundant in the skin. Dr. von Lendenfeld informs me that he now believes his *Euspongia canaliculata* to belong to the genus *Hippospongia*. At the time when he wrote his description of it he believed it to be identical in part with Mr. Carter's *Euspongia anfractuosa*, notwithstanding which he gave it a new name of his own, citing *Euspongia anfractuosa* as a synonym. Doubtless in his forthcoming monograph of the horny sponges this most perplexing question will be further elucidated.

EXPLANATION OF THE PLATES.

Plate IX.

Fig. 1. *Suberites inconstans*, var. *globosa*, × $\frac{1}{3}$.
Fig. 1 *a*. The same; tylostylus, × 190.
Fig. 2. *Suberites inconstans*, var. *digitata*, × $\frac{1}{2}$.

Plate X.

Fig. 1. *Suberites inconstans*, var. *mæandrina*, × $\frac{1}{2}$.
Fig. 1 *a*. The same; portion of upper surface, nat. size.

Plate XI.

Fig. 1. *Axinella Donnani*, × $\frac{5}{6}$.
Fig. 2. *Phakellia Ridleyi*, nat. size.
Fig. 2 *a*. The same; stylus, × 284.

Plate XII.

Fig. 1. *Raspailia Thurstoni*, × $\frac{2}{3}$.
Fig. 1 *a*. The same; three of the spined styli, × 284.
Fig. 1 *b*. The same; smooth stylus, × 284.
Fig. 2. *Raspailia fruticosa*, × $\frac{2}{3}$.
Fig. 2 *a*. The same; very long, slender stylus, × 284.

XVII.—*On the* Pyrochroidæ *of Japan.*

By George Lewis, F.L.S.

The collection made in Japan in 1880 and 1881 contains twelve species of Pyrochroidæ, and there is a certain similitude between them and those known from the United States; this will be seen best from the following table, which gives the genera and number of species of both countries :—

	Japan.	America.
Ischalia	1	1
Pyrochroa	6	2
Schizotus	3	1
Dendroides	2	4

The other known members of the family are: from Europe six, Northern Asia and China four, Java one, Borneo one, and Australia one.

The Javan species, *Pyrochroa longa*, Perty, as the name implies, has a very different outline from any of the others, and in the British Museum there are two undescribed species, also from Java, which resemble it. But the table given above must be taken with qualification or it will lead, if it lead to any conclusion at all, to speculation of a poor sort. It merely gives the divisions of the family found in Japan and America according to the present generic arrangements, and all such assortments are necessarily more or less provisional and liable to change with an increase of knowledge. There is hardly a family perhaps in the Coleoptera of which so little is known as the Pyrochroidæ. The Japanese species of *Dendroides* are in several repects different from those known from America; and although I consider it will not at any time be desirable to establish a genus to hold them, their discovery materially enlarges the scope of *Dendroides*. And when the comparative value of the table is examined, inquiries must also be undertaken as to the extent of the researches yet made in Japan and America. Are they or are they not relatively complete? The species in Japan are local, and the inference therefore is that more discoveries may be made which may modify any views put forth, and the American continent is so vast that it seems safe to predict the same thing of it.

I am led into making these observations because Herr H. J. Kolbe, of Berlin, has lately published, in the 'Archiv für Naturgeschichte,' 1886, p. 142, eleven well-arranged tables showing the distribution of some Korean Coleoptera. The tables show great care in their elaboration, but they are based on such insufficient material that it is impossible to assign to them any value. Only 142 species are enumerated, and some of these are not, in my opinion, characteristic of the Eastern fauna. I no not refer especially to those that are usually called cosmopolitan insects, such as *Dermestes*, *Necrobia*, *Gibbium*, certain *Aphodii*, &c., but to others which have a very wide distribution and are species familiar to most coleopterists. The publication of geographical statistics for the Coleoptera of China, Korea, and Japan is premature now, and will, I think, remain so until the important region lying between

Pekin, Canton, and the Himalayan mountains is fairly well investigated, and the material brought to Europe or taken to America and worked out. From ten to fifteen thousand species would be a very moderate collection for this territory. Within its limits there are large forests of both deciduous and evergreen trees growing at all the various altitudes of the district, and the contents of them are, practically speaking, unknown. It is not the low-lying areas which nurture and harbour the distinctive species of the Japanese fauna, these mostly yield *Bembidia* and certain Hydradephaga and Staphylinidæ, which are much the same all the world over; there as elsewhere the higher altitudes give the characteristic species. The names of five or six of Herr Kolbe's species will ultimately rank as synonyms, a result inseparable from working on scant material. Korea is now being opened up to foreign trade, and more and more every year will travellers visit the country, and the natural history be gradually worked out, while the laying down of railways in China will facilitate the making of collections there; and what I fear may happen is, that the species described from Japan will not sufficiently engage the attention of authors when at work on the new material, and the result will be the creation of duplicate names.

If this paper therefore should fall into the hands of any entomologist who, in the course of writing a memoir, should desire to examine specimens of any Japanese species I possess, I shall be glad to submit to him compared types of all I can. For this purpose I have retained as long a series as possible of every species, and any labour on my part will be bestowed cheerfully that may tend to gain one end I desire, namely, to see a Catalogue of Japanese Coleoptera more free of synonyms than any other local list yet issued. Under the present rules of nomenclature the deletion of a single name is impossible, and I know synonyms cannot be avoided altogether, but, so far as the loan of types can go to prevent them, I am willing to do what I can. I do not wish it to be understood that I think an author may not legitimately refuse to acknowledge the existence of types and decide to be guided by the literature alone, I only offer the loan to those to whom it may be acceptable.

The *Pyrochroa rufula*, described in 1860 by Motschulsky, is not in the present series, and, as it formed part of Madame Gaschkevitch's collection, some doubt exists whether it really came from Japan. It has never transpired that this lady labelled her collections, but it is now pretty well established that some of the Lucanidæ of the collection were gathered on

the Asian continent. Motschulsky's knowledge of Japan at the time when the country had been opened to Europeans but two years was necessarily small, and it is reasonable to doubt whether he thought it a matter of much importance to keep the Japanese species separate from those of Dauria. In the map, Schrenck, Reisen &c. ii. 1860, Hakodate is spelt "Khokodady" and placed in the north of Yezo, whereas it is in the extreme south, close to Matzumai, which is inserted in the chart correctly.

The following is a list of the species referred to in this paper :—

Ischalia patagiata, *Lewis*.
Pyrochroa vestiflua.
—— laticollis.
—— brevitarsis.
—— peculiaris.
—— japonica, *Heyden*.
—— atripennis.
Schizotus rubricollis.
—— auritus.
—— gibbifrons.
Dendroides niponensis.
—— ocularis.
———
Pyrochroa rufula, *Motsch*.

Ischalia patagiata, Lewis.

Ischalia patagiata, Lewis, Ann. & Mag. Nat. Hist. 1879, iv. p. 463.

Oblonga, depressa, nigra, parce albo-hirta; antennis pedibusque obscure nigris; elytris externe late luteo marginatis. L. 5–5½ mill.

Oblong, depressed, black, with the elytra broadly margined with yellow, the yellow band occupies half the width of each elytron until just before the apex, when it is confined to the dilated rim of the elytron. The head projects on each side to receive the antennæ; the eyes are rather coarsely granulate, with the space behind rather shining, convex, and sparsely punctured. The thorax is rather elevated behind the neck, with distinct lateral margins, and there is a longitudinal carina before the scutellum which occupies about one third of the length of the thorax, on each side of the carina is a transverse depression. The suture of the elytron is raised and the humeral angle dilated, its outer ridge forming the commencement of the elytral carina, which terminates just before the apex, just beyond the point where the yellow margin narrows. I do not see any sexual characters.

In 1881 I obtained four specimens in Hiogo and two at the foot of Miyasan, one of the original localities.

The American species of this genus was described as *Eupleurida costata* by Leconte in 1866; but Pascoe's *Ischalia indigacea* from Borneo was published in 1860, and his generic name has priority. Crotch first included *Ischalia* in the Pyrochroidæ.

Pyrochroa vestiflua.

Elongata, nigra, subnitida; fronte modice excavata, antice tuberculata; elytris rufo-brunneis, postice dilatatis. L. 10–17 mill.

Elongate, black, somewhat shining; head transversely excavated in front of the eyes, and between the antennæ there is a small tubercle on a short longitudinal ridge. The first joint of the antennæ is rather long and constricted before the base, the base being abruptly enlarged; the second joint is about one third the length of the first and slightly smaller before its base; the third joint is as long as the first and at its apex is the first pectinal tooth or branch, which in the male is as long as the joint itself; the next seven joints have subapical processes which are nearly three times the length of each joint; the terminal joint is (as in other species) long and simple; in the female the branch of the third joint is short and rather obtuse, the following joints bearing branches which gradually lengthen until the tenth joint, when the prolongation is half as long again as the segment. The thorax is clothed with a cinereous pile and anteriorly rounded at the sides, with a median depression which widens out before the scutellum; there are also two irregular depressions on each side. Scutellum somewhat rounded behind, black, and rugosely punctured. Elytra reddish brown, with concolorous pile, closely and rather transversely rugose and for three fourths of their length rather amply dilated. Legs intensely black with pale claws. The female has the forehead much less excavated than the male and the tubercle is less defined.

The larvæ, pupæ, and imagos were found together under bark of beech, April 21, 1880, at Suyama, and the perfect insect afterwards was found commonly at Miyanoshita, Nikko, Sapporo, Oyayama, and other places.

Pyrochroa laticollis.

Elongata, nigra, subnitida; capite puncticulato, fronte utrinque excavata; thorace transverso post oculos subrecto. L. 10–11 mill.

This is very similar to the last in colour and form of the antennæ, but it is much smaller and has a transverse thorax. The head is finely and rather thickly punctured, and the transverse region between the antennæ and the eyes is excavated on each side, with a dividing central portion much less deep. The thorax is rather straight behind the head, with a very distinct angle on the outer edge behind the middle; the depressions are much as in *P. vestiflua*.

I possess six females, but do not know the male. The localities for it are Ichiuchi, Subashiri, Miyanoshita, and Oyayama.

Pyrochroa brevitarsis.

Elongata, nigra, subnitida; fronte transversim subexcavata, inter antennas subelevata; pronoto parum transverso utrinque biangulato; elytris testaceo-brunneis. L. $8\frac{1}{2}$ mill.

Head with an interantennal elevation with a median but small tubercle, the transverse space between the eyes and antennæ is slightly excavated. The thorax is anteriorly straight behind the neck, and then shelves off to a point, which, viewed over the elytra, looks like an angle; posteriorly, as in *laticollis*, there is another well-defined angle. The scutellum is black, and the thoracic depressions do not visibly differ from those of the preceding species.

There is no doubt about this species being distinct from the last on account of the size, thoracic angles, and shorter posterior tarsi.

Two examples, both females, were taken in the highest region of Kadzusa, April 5, 1880. In this part the plantations are chiefly of *Abies* and *Pinus*.

It is the smallest species known from Japan at present.

Pyrochroa peculiaris.

Elongata, nigra, subnitida; fronte bifoveolata; elytris piceis pilo rufo-brunneo. L. 9–11 mill.

Elongate, black, little shining. Head and thorax with an ashy pubescence; elytra piceous and clothed with a reddish-brown pile, which gives a peculiar dark tint to the whole. The forehead in the male has two deep foveæ between the antennæ, and the transverse space between the eyes and the antennæ is thickly clothed with pubescence; between the eyes the surface is sparsely puncticulate; neck rather thickly punctate. The first joint of the antenna is somewhat compressed, second trigonate, third with a subapical branch, fourth to tenth with pectinal processes longer than the joints. The female has no frontal foveæ, but the transverse depression before the eyes is more distinct, the head generally more thickly punctured, and the antennæ obtusely pectinate. The thorax is round in both sexes, and the elytra but moderately dilated and rugosely sculptured.

I took this species in August, four specimens in South Yezo and one on Niohozan, above Nikko.

The two following species have slender tarsi and an interocular protuberance in the male :—

"*Pyrochroa japonica*, Heyd., ♀.

"*Pyrochroa japonica*, Heyd., ♀, Deutsche ent. Zeitschr. xxiii. 1879, Heft ii. p. 354.

" Depressa, obscure rufo-coccinea, antennis pedibusque nigris, ore, thorace lateribus nigris, fronte nigra; capite inter oculos fortiter transverse elevato, antice laxe excavato. Thorace minore, parum latiore quam longiore, lateribus post medium angulatis, ante medium transverse late impresso, linea media canaliculata in foveam antescutellarem effundente. Elytris plus quadruplo thorace longioribus, ante medium dilatatis, transverse densissime rugosis, in utroque lineæ duæ e rugis obliquis plumiformibus latioribus. Palporum articulis primo minuto rufo et secundo quarto æqualibus, tertio breviore et angustiore, quarto lateribus parallelis, basi apiceque acuminatis. Antennæ partim desunt, articulis 1 et 3–6 longitudine æqualibus, primo basi attenuato, 3–6 sensim fortiter ramosis, fortius (jam in tertio) quam in *P. pectinicorni*, cui affinis sed major. L. 11 mill."

The male of this species has the pectinate branches of the antennæ very long, and in joints six to nine the processes are more than three times the length of the joint that bears them. Between the eyes there is a large vertical protuberance, which is connected with the forehead by a median ridge, which, viewed sideways, is usually seen to come to a raised point immediately behind the antennæ; but in several examples this elevation is obsolete. In two specimens the vertical protuberance examined from above is divided on its upper surface into two lobes. Heyden only knew the female.

I have a series of about thirty examples from Subashiri, Kiga, and other places lying under Mount Fujisan, and also a few from Nikko.

Pyrochroa atripennis.

Atra, opaca; capite antice palpisque flavis; thorace rufo. L. 11 mill.

Black; head between the antennæ and the mouth-organs, except the tips of the mandibles, flavous. In the male there is a broad flattish protuberance on the head, which has its base between the eyes, and, projecting forwards, is somewhat truncate anteriorly and rounded off on each side, with two impressions on the upper surface, which leave the margins and a median division raised. Thorax red, sometimes a little transverse, with a cinereous pile and two lateral impressions

and one rather deep and broad before the scutellum; scutellum posteriorly semicircular, black and opaque, like the elytra, the latter rugose and moderately dilated behind; legs black with yellow claws. The female has the head transversely convex between the eyes, a slight longitudinal ridge between the antennæ and a small boss-like elevation on each side close to them; the epistoma is flavous and the palpi black.

Whether this last character is really sexual or whether the coloration is inconstant in the species must remain at present uncertain, as I have but one female.

Found by sweeping under brushwood in June on Omine in Yamato, and at Chiuzenji. Four examples.

I have one more species of *Pyrochroa* from Miyanoshita which is unique, and I do not describe it. Its head is rather thickly punctured.

Pyrochroa rufula.

Pyrochroa rufula, Motsch. Bull. Soc. Mosc. 1866, p. 173.

"Statura et color *Pyrochroa pectinicorni*, sed major. Oblonga, depressa, opaca, supra rufo-coccinea, pubescens, corpore subtus, fronte, ore, oculis, antennis subserratis, pedibusque nigris; thorace transverso, longitudinaliter triimpresso; elytris thorace latioribus, postice subdilatatis, nervis vix distinctis. Long. $3\frac{1}{4}$ l. (about 7 mill.) lat. $1\frac{4}{5}$ l."

The measurements given above are less than those of *P. pectinicornis*; but the diagnosis expresses a contrary statement.

Schizotus rubricollis.

Elongatus, subparallelus; fronte in medio longitudinaliter carinata utrinque valde excavata; elytris thoraceque rufis. L. 9 mill.

Elongate and posteriorly scarcely dilated; head between the eyes transversely convex and sparsely puncticulate, the convexity being broadest close to the eyes; the region before the eyes is deeply excavated, with a polished longitudinal ridge in the centre of the excavation which terminates before the interocular raised or convex portion, and at the point of termination there is a triangular excavation deeper than that of the sides; bordering the carina the head is more or less reddish; the neck is red and somewhat coarsely punctured. Thorax uneven, a little raised in two portions behind the neck, with similar raised parts before the scutellum; the raised portions are a little polished. Scutellum a little

prolonged and transversely depressed in the middle; elytra red and rugose. I know the male only.

Captured at Miyanoshita, May 1880.

Schizotus auritus.

Elongatus, niger, subnitidus; capite inter oculos elevato, ante oculos profunde excavato. L. 9 mill.

Black, rather shining; elytra alone reddish brown. Head a little transverse, with the region between the eyes greatly elevated, the elevation or protuberance being divided into two portions by a median depression; the surface is distinctly but not densely punctured; this protuberance is excavated anteriorly, and within the excavation are long flavous hairs. The region between the antennæ is transversely canaliculate, with the space anterior to it roughly sculptured, with two rather deep lobe-shaped foveæ. The thorax is transverse, distinctly punctured, and has the usual depressions of the genus on either side and in the middle. Scutellum black, a little prolonged; elytra rugose, not much dilated behind. The tarsi are rather slender, with pale claws. The female has a transverse depression between the eyes and the antennæ; but it is not deep and does not quite approach the eyes. The first joint of the antennæ is much constricted before the base in both sexes, and the anterior portion is somewhat globular in the male.

Six specimens were taken on the plain of Fujisan and one on Ontake.

Schizotus gibbifrons.

Elongatus, niger; capite regione inter oculos perconvexa; thorace basi anguste rufo. L. 10 mill.

Elongate, black; posterior margins of the thorax narrowly red; elytra reddish brown. Head with a well-marked oval boss between the eyes, shining and distinctly punctured; forehead slightly and narrowly elevated between the antennæ, with the space intervening between the eyes depressed. The surface of the thorax is uneven, but has little to distinguish the species from its congeners; the anterior angles are round. The scutellum is black, rather lengthened, depressed transversely in the middle, and posteriorly more acuminate than in *S. auritus*. Elytra as in preceding species. The female is very like the male, except that the interocular space is simply convex and the antennæ less pectinate.

Five examples, found on Oyayama in Hiogo, May 1881.

The American species of *Dendroides* have the elytra with distinct punctures separated from each other by a wide interstice. The Japanese species have the elytra closely sculptured as in the genus *Pyrochroa*; this sculpture is sometimes called coriaceous, but I think Dr. Heyden's "transverse densissime rugosis," applied to *Pyrochroa japonica*, is the better description of it.

Dendroides niponensis.

Elongatus, piceus; fronte excavata; elytris rufo-brunneis, antice subparallelis, postice parum dilatatis. L. 17 mill.

Elongate and relatively little dilated behind; elytra piceous, with a reddish-brown pile, which together give a tint which inclines to pink. The general colour simulates to that of *P. peculiaris*, in which also the elytra are different in colour from the pubescence. Head excavated between the antennæ and in the region of the anterior portions of the eyes; between the hinder portions of the eyes the surface is glabrous and shining; neck punctured; thorax rather round behind, but slightly constricted behind the neck, with a cinereous pile; surface uneven. Scutellum blackish, broadest at base, gradually rounding off towards the apex. Legs black; claws yellow. The antennæ are strongly pectinate in both sexes, the pectination being longer and narrower in the male, shorter and more robust in the female.

The chief sexual characters are in the eyes. The eyes in the female are small and the interocular space double the width of that in the male, and the frontal excavation is shallow.

I obtained it at Kashiwagi, Nikko, Chiuzenji, and Akita.

Dendroides ocularis.

Elongatus, piceus; fronte haud excavata, punctata, oculis in medio approximatis. L. 13 mill.

Elongate, with the outline of the last species; epistoma slightly convex and a little rugosely punctate; eyes very prominent and above almost touching in the male; neck rugosely punctured; thorax slightly constricted before the base, lateral depressions deeper than those of the middle; scutellum black; elytra reddish brown. The female has a smaller head than in the preceding species, and the interocular space is about as wide as in the male of *D. niponensis*, and it is less shining and more punctured than in the male of its own species.

The two prominent characters which separate this species from the last are the want of frontal excavation and the very narrow space between the eyes in the male.

I possess three examples from Miyanoshita and one from Kashiwagi.

XVIII.—*On a new Species of* Semionotus, *from the Lower Oolite of Brora, Sutherlandshire.* By A. Smith Woodward, F.G.S., F.Z.S., of the British Museum (Natural History).

[Plate VII.]

Through the kindness of Prof. J. W. Judd, F.R.S., I have received from the Rev. J. M. Joass, LL.D., of Golspie, Sutherlandshire, some examples of an interesting fossil ganoid fish, from the Lower Oolites exposed in that district upon the coast. The specimens were discovered in a block of carbonaceous shale, believed by Dr. Joass to have been derived from the bed underlying the main seam of lignite in Strath Brora; and, as will appear from the description and figures, they are referable to a hitherto unknown species of *Semionotus*, adding one or two important items to our knowledge of the skeleton of this early genus *. Detached scales have already been recorded by Prof. Judd †, but no remains sufficiently perfect for specific determination seem to have been previously met with.

The most complete fossil (Pl. VII. fig. 1) shows the general form of the fish, with all the fins except the pelvic pair; but the shape and relations of the bones in the cephalic region have been rendered almost undistinguishable by crushing. A second specimen, with a portion of its counterpart, but destitute of the caudal fin, is even more dilapidated, though exhibiting some of the bones of the head and opercular folds. A fragment of a third individual shows a well-preserved pectoral fin and the upper lobe of the caudal pedicle; while a fourth is represented by its apparently entire caudal fin. A detached maxilla also displays the characters of that bone and its dentition.

* The most complete description of *Semionotus* hitherto published is by J. Strüver, "Die fossilen Fische aus dem Obern Keupersandstein von Coburg," Zeitschr. d. deutsch. geol. Gesellsch. vol. xvi. (1864) pp. 305–321, pl. xiii.

† J. W. Judd, "The Secondary Rocks of Scotland.—Part I.," Quart. Journ. Geol. Soc. vol. xxix. (1873) p. 194 (table).

Description.

As shown by Pl. VII. fig. 1, the fish is of a graceful fusiform shape, the greatest depth, slightly in advance of the dorsal fin, being contained about three and a half times in the total length. The head and opercular bones occupy not quite a third of the total length; and, as usual in the genus, the dorsal and anal fins are remote.

The *head-bones*, as just stated, are so much crushed that the complete outline of very few can be distinguished. The exposed surfaces seem to have been smooth, or only partially ornamented with scattered tubercles; but it is impossible to determine to which parts the ornament was confined. Of the inner bones, there are the remains of a pair, evidently vomerine or palatine, bearing series of stout conical teeth; and of the more external elements, the characters of the premaxilla and maxilla can be observed.

The *premaxilla* (fig. 2) constitutes but a small portion of the upper border of the mouth, and bears at least five strong conical teeth; it is produced above into a broad backwardly-directed process, the length of which is about twice as great as that of the dentigerous margin of the bone. The entire form of the element is remarkably similar to that of *Lepidotus*. The *maxilla* (fig. 3) has also a close resemblance to the corresponding bone in the last-named genus; it is very narrow in its anterior half, but becomes rapidly deeper behind, and the posterior portion attains a depth equalling about a third of the entire length of the dentigerous border; there is also articulated with the upper edge of this expansion a small distinct element, which may be interpreted either as jugal or as merely a dismemberment of the maxilla itself. The teeth are sharply conical and somewhat irregularly disposed, the larger ones being relatively far apart, and the smaller ones being closely set in the interspaces.

The posterior *branchiostegal rays* (fig. 4) are very broad distally, gradually tapering to the attached end; and between the rami of the mandible there is a large median *gular plate*. An impression of the inner aspect of the latter (fig. 5) is well shown in one of the specimens; its anterior half is almost horseshoe-shaped, and appears to be divided from the posterior broader portion by slight lateral notches.

Displaced and situated above the crushed head in the less perfect specimen, is a well-preserved scale-bone, which appears to be one of the series originally attached to the posterior margin of the pectoral arch. This (fig. 6) is vertically elongated, its length being equal to twice and a half its greatest breadth. It is of the form of a parallelogram, with

the antero-inferior angle slightly produced downwards, and the postero-superior somewhat rounded; but the upper two thirds of the anterior border were evidently considerably overlapped, leaving the exposed portion of the bone broader below than above. The outer enamelled surface is merely covere with scattered pittings and exhibits no ornamentation.

Of the *paired fins*, the pectorals (fig. 1) are long and powerful, but the pelvics are almost, if not quite, undistinguishable. The latter are always more or less rudimentary in *Semionotus*, but they seem to have been unusually small in the species now under consideration. Each pectoral fin consists of about ten robust rays, undivided for more than a third of their length, then becoming articulated and soon branching.

In the *median fins* the rays are similar to those of the pectoral just described—robust, proximally undivided, distally articulated and branching. The dorsal (fig. 1) is unfortunately mutilated, but there are traces of the double series of anterior fulcra, followed by about fourteen rays; and the fin is seen to commence in the middle of the back. The anal (fig. 1) commences at a point opposite the posterior end of the dorsal, and is preceded by two prominent and other smaller fulcra; it is, as usual, of small extent, but composed of rays of considerable length. The caudal fin is best displayed in the fragment shown in fig. 7, though its connexions are also seen in two of the other specimens. The extremity of the body is slightly produced upwards—a kind of semiheterocercy—and the ridge-scales are continued behind as fulcra; the rays, however, are so disposed as to produce a completely symmetrical fin, and this is not forked, but somewhat rounded, the median rays extending beyond those above and below.

The *scales* are thick and covered externally with a smooth shining layer of ganoine. They are of rhomboidal form, varying slightly in different parts of the body, being deepest on the flanks (figs. 1, 8), and most oblique in the caudal region, while those of the ventral aspect (fig. 9) exhibit, to some extent, the elongation characteristic of genera like *Eugnathus*, &c. With one or two exceptions on the middle of the flank, none of the scales show the slightest trace of denticulations on the hinder edge. None, moreover, appear to be united by "peg-and-socket" joints; but there is the usual slight overlapping, and all are strengthened on the inner side by a vertical median rib.

Specific determination.

In his original description of the genus *Semionotus*, Prof.

Agassiz recognized six species—one from the Keuper and five from the Lias; in 1843 Sir Philip Egerton described three others from the Lower Jurassic of Italy, and in 1872 one from the English Kimmeridge Clay; a fourth Italian species was added by Costa, and two additional Keuper forms have been subsequently discovered—the one named by Dr. Oscar Fraas, from Württemberg, the other described by Mr. E. T. Newton, from Warwickshire.

Thirteen species have thus been referred to the genus under consideration, and of these the position of three seems doubtful, on account of the imperfection of known specimens, while a fourth may be unhesitatingly regarded as wrongly so placed. The three former are the Italian species described by Egerton, and the smallest of these (*S. minutus*) may eventually prove to be truly a *Notagogus*. The fourth species is the so-called *S. rhombifer*, Agass. *, from the Lower Lias of Lyme Regis, which Sir Philip Egerton has already recognized † as exhibiting a very close resemblance to *Heterolepidotus*. There can, indeed, be no longer any doubt that the fish in question belongs to the last-named genus, and the type specimen is quite possibly a young individual of *H. latus*, Egerton.

Tabulating the remaining twelve species, it will be convenient for reference to place them in stratigraphical order as follows; and to those of which the type specimens are now preserved in the British Museum an asterisk is prefixed.

Semionotus, Agassiz.

Semionotus Bergeri, Agass. Rech. Poiss. Foss. vol. ii. pt. 2, p. 224, pl. xxvi. figs. 2, 3. *Palæoniscum arenaceum*, Berger, Verstein. Coburg. Gegend, 1832, p. 18, pl. i. fig. 1. *Semionotus Spixi*, Agass. *tom. cit.* p. 8. *Semionotus esox*, Berger, Neues Jahrb. 1843, p. 86. *Semionotus Bergeri*, von Schauroth, Zeitschr. deutsch. geol. Ges. vol. iii. (1851), p. 405, pl. xvii.; Bornemann, *ibid.* vol. vi. (1854), p. 612, pl. xxv.; Strüver, *ibid.* vol. xvi. (1864), p. 305, pl. xiii. figs. 1, 3, 4. —Upper Keuper, Coburg.

Semionotus Kapffi, Fraas, MS.—Keuper, Württemberg.

Semionotus Brodiei, Newton, Quart. Journ. Geol. Soc. vol. xliii. (1887) p. 537.—Keuper, Warwickshire.

Semionotus latus, Agass. *tom. cit.* p. 227, pl. xxvii. *Dapedius altivelis*, Agass. *tom. cit.* p. 8.—Lias, Seefeld, Tyrol.

**Semionotus striatus*, Agass. *tom. cit.* p. 231, pl. xxvii. *a*. figs. 6, 7. —Lias, Seefeld, Tyrol.

Semionotus Nilssoni, Agass. *tom. cit.* p. 229, pl. xxvii. *a*. figs. 1–5; Nilsson, Trans. Acad. Sci. Stockholm, vol. xii. (1824), p. 103, pl. ii. figs. 1–3.—Lias, Schonen, near Bosarp, Sweden.

Semionotus leptocephalus, Agass. Neues Jahrb. 1832, p. 145; also *tom. cit.* p. 222, pl. xxvi. fig. 1.—Lias, Boll, Württemberg.

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* L. Agassiz, Rech. Poiss. Foss. vol. ii. pt. 1, p. 228, pl. 26 *a*.

† Egerton, Figs. and Descr. Brit. Org. Remains (Mem. Geol. Surv.), dec. xiii. pl. ii.

Semionotus curtulus, Costa, Paleont. del Regno di Napoli, pt. 1 (1850), p. 64, pl. vi. figs. 4, 5, pl. vii. fig. 6, pl. viii. fig. 2; pt. 3, p. 81, pl. xi. fig. 1; also Ittiol. Foss. Ital. 1855, p. 25, pl. iii. fig. 1.—Lias, Giffoni, near Naples.

**Semionotus Pentlandi*, Egerton, Proc. Geol. Soc. vol. iv. 1843, p. 183. —Lias, Giffoni, near Naples.

**Semionotus pustulifer*, Egerton, *loc. cit.*—Lias, Giffoni, near Naples.

**Semionotus minutus*, Egerton, *loc. cit.* [? = *Notagogus*].—Lias, Giffoni, near Naples.

**Semionotus Manselii*, Egerton, Figs. and Descrip. Brit. Org. Remains (Mem. Geol. Surv.), dec. xiii. pl. viii. (1872).—Kimmeridge Clay, Dorsetshire.

Comparing the Brora fossil with each of the foregoing forms it soon becomes evident that the fish is specifically distinct. *S. Bergeri* obviously differs in the prominence of the serrations on the scales, and the larger size of the fin-fulcra, though agreeing well in general proportions. *S. Kapffi* and *S. Brodiei* are smaller species, and the former is considerably less fusiform. *S. latus* is likewise a much shorter and deeper species; and *S. striatus* is distinguished by the character of the superficial ornamentation of the head. *S. Nilssoni* has the scales of the flanks more vertically elongated, and is a comparatively deep-bodied fish. *S. leptocephalus* is very similar to the Brora fossil in general outline, but the tail is relatively smaller and the fin-rays apparently less robust. *S. curtulus*, *S. Pentlandi*, and *S. pustulifer* must have been all less elongated; while *S. minutus*, if really referable to the same genus, differs in the delicacy of the fin-rays and its remarkably elongate shape. Lastly, *S. Manselii* is readily separated by its larger dimensions, the well-developed pelvic fins, and the relatively greater depth of the trunk.

It thus becomes necessary to propose a new name for the species here described, and I would suggest that of *S. Joassi* as being most appropriate, in reference to the valuable researches of the Rev. Dr. Joass upon the geology of the north-eastern margin of the Highlands.

EXPLANATION OF PLATE VII.

Semionotus Joassi, A. S. Woodw., Lower Oolite, Brora, Sutherlandshire.

Fig. 1. Nearly complete fish; nat. size.
Fig. 2. Premaxilla; thrice nat. size.
Fig. 3. Maxilla; thrice nat. size.
Fig. 4. Posterior branchiostegal ray; twice nat. size.
Fig. 5. Gular plate; twice nat. size.
Fig. 6. Postclavicular plate; twice nat. size.
Fig. 7. Caudal fin; nat. size.
Fig. 8. Scales of flank, inner aspect; twice nat. size.
Fig. 9. Ventral scales, inner aspect; twice nat. size.

XIX.—*Description of a new Genus of Chalcosiid Moths allied to* Pedoptila. By Arthur G. Butler, F.L.S., F.Z.S., &c.

In the 'Annals' for 1885, vol. xv. pp. 340–342, I described a remarkable new genus of moths allied to *Himantopterus*; the type was from Cape Coast and in the collection of Mr. F. Swanzy, who has since presented it to the Trustees of the British Museum.

A second genus from Zanzibar was described by Herr Rogenhofer, of Vienna, under the name of *Doratopteryx*, in the 'Sitzungsberichten der k.-k. zoolog.-botan. Gesellschaft in Wien' (vol. xxxiii.); and in the 'Annals' for 1885, vol. xvi., I have compared the characters of the two genera *Pedoptila* and *Doratopteryx*, pointing out in what respects they differ both in structure and aspect.

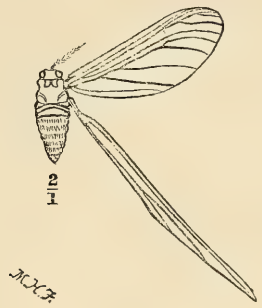
Whilst recently looking over some Lepidoptera brought to me for examination by Mr. Philip Crowley, I was delighted to find a third very distinct genus of this group, nearer to *Pedoptila* than to anything else hitherto described, but differing remarkably in neuration and in the form of the secondaries.

Semioptila, gen. nov. (*σημεῖον*, *πτίλον*).

Nearest to *Pedoptila*: primaries more elongated and narrower, the subcostal vein four-branched, an extra nervule being emitted before the end of the cell, the second and third branches forming a narrow apical furca, the fourth emitted also at some distance beyond the cell, as in the case of the third branch of *Pedoptila*; cell open, the termination only indicated by a darker transverse line on the surface of the wing; upper radial reduced to a false vein, thickest at outer margin, and passing through the cell almost to the base of the subcostal vein; lower radial emitted as a fourth median branch, but not from the same point with the third median (as in *Pedoptila*); submedian vein much more nearly approaching the first median branch at its distal extremity: secondaries elongate trigonate, apparently twisted over, so as to bring the costal margin next to the body, in which position it is naturally retained, the anal angle of the wing is thus represented by an obtusely angulated apex, and the apex by an acute anal angle; the subcostal vein, which is forked before the apex, thus represents a two-branched median vein, whilst the median vein becomes a simple subcostal vein *; discoidal cell open as in the primaries: body

* Thus viewed, the three veins remain as in *Pedoptila*, the wing itself being altered in shape and reversed.

very similar to that of the allied genera, the abdomen, however, is closely but coarsely scaled.



Semioptila torta, sp. n.

Wings transparent, sparsely scaled, the basal half with rust-reddish or reddish-orange scales, the outer or terminal half with brown scales; secondaries with an oval orange spot beyond the cell; body pitchy brown, the abdomen with cupreous-brown scales; vertex of head and collar orange: under surface pale brown, with a few orange hairs on the pectus. Expanse of wings 24 millim.

Congo (*coll. P. Crowley*).

XX.—*Bryozoa from New South Wales, North Australia, &c.*

By Arthur Wm. Waters.

[Plates V. & VI.]

Part II.

25. *Membranipora nitens*, Hincks.

Membranipora nitens, Hincks, Ann. & Mag. Nat. Hist. ser. 5, vol. vi. p. 85, pl. xi. fig. 4.

Membranipora porcellana, MacGillivray, Trans. Roy. Soc. Vict. 1884, vol. xxi. p. 110, pl. ii. fig. 3.

Bathypora porcellana, MacG., Zool. Vict. dec. xi. p. 26, pl. 106. fig. 8.

Loc. Portland and Port Phillip (Victoria); Shoalhaven Beach (N. S. Wales).

26. *Membranipora Savartii* (Aud.).

For synonyms see Waters, Quart. Journ. Geol. Soc. vol. xli. p. 286, and *Membranipora deliculata*, Hincks, Ann. & Mag. Nat. Hist. ser. 5, vol. vi. p. 86, pl. xi. fig. 1.

Membranipora reticulum, Pergens, Plioc. Bry. von Rhodos, Ann. k.-k. Hofmuseums, Wien, Bd. ii. p. 14.

A specimen from Palm Island has the zoarium in the *Vincularia*-form, sometimes anastomosing, and, as I have pointed out in a previous communication, it has "denticles" in all the zoœcia. Part of the colony has the zoœcia surrounding the stem of a seaweed, and in other parts the stem is solid without any support. This is, as already shown, the *Biflustra delicatula* of Busk and MacGillivray.

There is also a small fragment from Darnley Island, Torres Straits, with a single row of zoœcia on each of the four sides; the shape of the cells is similar to the above but not identical, being more elongate, straighter, and somewhat larger, with similar "denticles." It may be the *Vincularia quadrilatera* of d'Orb. (Pal. Fr. p. 189, pl. 681. figs. 1–3), though from so small a fragment it is impossible to speak with certainty, so in the meantime I call it *M. Savartii*, var. *quadrilatera*, d'Orb. (Pl. IV. fig. 8).

Loc. Cretaceous, France; Miocene, Austria; Pliocene, England, Italy, Sicily. Living: Florida, 29 fath.; Victoria; Queensland; Philippine Islands; Penang, &c.; Palm Island, N.E. Australia, 8–10 fath.

27. *Membranipora corbula*, Hincks.

Membranipora corbula, Hincks, Ann. & Mag. Nat. Hist. ser. 5, vol. vi. p. 378, pl. xvii. fig. 6; MacGillivray, Zool. Vict. dec. xiii. p. 103, pl. 127. fig. 2.

In a specimen from Shark Island the number of spines is somewhat variable, there being sometimes two large spines and three smaller oral ones.

Loc. Victoria; Shark Island, 8 fath., Sow-and-Pigs Reef, Port Jackson, 3–4 fath., and Bottle-and-Glass Rocks, 8 fath., N. S. Wales.

28. *Membranipora spinosa* (Q. & G.).

Membranipora spinosa, Waters, Quart. Journ. Geol. Soc. vol. xliii. p. 48, pl. viii. fig. 32, for synonyms, and add MacGillivray, Zool. Vict. dec. xiii. p. 107, pl. 127. fig. 8.

In specimens from Vaucluse Point there is in the interior what we may call a strengthening plate, at each side towards the distal end, starting from the base of the zoœcium, and attached also to the border of the opesia. This I figured in the fossil from Napier, where it is well marked and forms a chamber on each side.

The basal wall is only membranous, but in many cases there is an oval space of thicker membrane or chitin.

MacGillivray calls the spines rigid, and although this is a

correct description yet when they are calcined there is found to be an organic circle at the base; the spines nevertheless hold together, showing that this surrounds calcareous matter.

The rosette-plates are small and numerous, forming a line along the middle of the wall.

Loc. Living: Victoria; Kerguelen Island; S. Patagonia; New Zealand; Holborn Island; Vaucluse Point, Port Jackson, 5 fath. Fossil: Aldinga; Australia; and Napier, New Zealand.

29. *Membranipora roborata*, Hincks.

Membranipora roborata, Hincks, Ann. & Mag. Nat. Hist. ser. 5, vol. viii. p. 69, pl. ii. fig. 3; Waters, Quart. Journ. Geol. Soc. vol. xxxix. p. 433.

Flustra membraniporides, Busk, Challenger Report, p. 54, pl. xxxii. fig. 7 (unilaminate).

Craspedozoum ligulatum, MacGillivray, Descriptions of New or Little-known Polyzoa, pt. ix. p. 5, pl. i. fig. 3.

Craspedozoum spicatum, MacG. ibid. p. 5, pl. i. fig. 2.

Bilaminate specimens from Port Jackson have usually two avicularia, but sometimes only one, and the spines are small and not always found, but there are two on the outer corner of the outside zoœcia. This is broader than the unilaminate form from New Zealand, which has usually only one avicularium to a zoœcium. The ovicells in both are similar in character, though those from New Zealand have a rounded border. Busk does not mention the tubular fibres at the side of the zoarium. As I have pointed out, in the unilaminate form from New Zealand there are at the commencement of a new branch frequently chitinous tubes from cell to cell, so that they may be considered articulated. In the bilaminate specimens from Port Jackson there are sometimes chitinous tubes on the front passing from one zoœcium to another, sometimes to the next, at other times passing over several, and near the place where fresh branches are given off lateral tubes often start from central zoœcia.

Loc. Curtis Island; Port Jackson, 8 fath. (bilaminate) (*Braz.*); New Zealand; Port Phillip Heads; Bass's Strait. Fossil: Waurn Ponds (unilaminate).

30. *Membranipora Flemingii*, var. *minax*, B.

Membranipora minax, Busk, Quart. Journ. Microsc. Science, vol. viii. p. 125, pl. xxv. fig. 1; Hincks, Brit. Mar. Polyzoa, p. 169, pl. xxii. fig. 2.

Membranipora Flemingii, forma *minax*, Smitt, Krit. Fört. ö. Skand. Hafs-Bryozoer, Œfv. K. Vetensk.-Ak. Förh. 1867, pp. 368, 409, pl. xx. fig. 43.

A specimen from the Sow-and-Pigs Reef, Port Jackson,

has the zoœcia subhexagonal, surrounded by a raised ridge, the acute avicularia are placed transversely at the base of the zoœcium; the ovicell has a raised line enclosing an area, as in *M. flemingii*, and there do not seem to be any spines; but in spite of this slight difference from the European species it seems that it should be placed here. It is allied to both *M. Flemingii* and *M. umbonata*, B., but is a larger form than either, the zoœcia being about 0·5 millim. wide and the opesia 0·3 millim.

Loc. Of typical *minax*. Shetland; Greenland; Finmark; Bergen; Capri (*A. W. W*). Fossil: from the Pliocene of Pruma, Calabria (*A. W. W.*).

31. *Membranipora tripunctata*, Waters.
(Pl. V. figs. 12, 18, 19, 20.)

Membranipora tripunctata, Waters, Quart. Journ. Geol. Soc. vol. xxxviii. p. 262, pl. ix. fig. 35.

Zoarium cylindrical, about 1 millim. in diameter, articulated by means of numerous chitinous tubes given off from the front of the zoœcia near the articulation. The zoœcia have a prominent border, and usually an oval opesial opening in the middle of a calcareous lamina, in other cases nearly the whole of the front of the zoœcium is open.

Except in the ovicelligerous cells there is a wide depressed area above each zoœcium, and above this, or above the ovicell, are two narrow avicularia directed diagonally downwards. Specimens from Holborn Island, which are the best preserved, have a fornix on each side (attached to the middle of the side of the zoœcium), widening towards the end, and nearly meeting over the aperture; above these on each side is a club-shaped spine. There are also large raised triangular vicarious avicularia. The ovicell is smooth and considerably raised, with a circular border below the avicularia. Two rosette-plates near the base of the lateral wall.

The zoœcial characters are truly Membraniporidan and the fornices and spines may be compared with those of *M. cornigera*.

If it is not called *Membranipora* then it would be *Foricula*, d'Orb., and part of *Foveolaria*, Busk (Chall. Rep.), would also have to be brought under the same genus; for although that is defined as having one avicularium yet there are so many instances in which *Membraniporæ* have one or two avicularia in different parts of the same specimen that this cannot, in numerous cases, be considered of any specific value.

This and *Foricula aspera*, d'Orb. (Pal. Franç. p. 659, pl. 742. figs. 1–5), from the Cretaceous are allied.

When I gave the specific name I had overlooked the fact

that Hagenow (Bronn's Jahrb. 1839, p. 269, pl. iv. fig. 7) had called a fossil *Cellepora tripunctata*. From the figure and description it, however, seems like *M. Lacroixii*, Aud.

Loc. Fossil : Mt. Gambier. Living : N.E. Australia, 23 fath. (*Br.*) ; Holborn Island ; Broughton Island (N. S. W.) (*Miss Jelly coll.*).

32. *Diploporella cincta* (Hutton).

Membranipora cincta, Hutton, Trans. Roy. Soc. Tasmania, 1877, p. 23.
Diplopora cincta, MacG. Trans. Roy. Soc. Vict. vol. xvii. p. 1, fig. 1 (April 1880).
Diploporella cincta, MacG. ibid. vol. xxi. p. 98.
Membranipora transversa, Hincks, Ann. & Mag. Nat. Hist. ser. 5, vol. vi. p. 89, pl. xi. fig. 9 (July 1880) ; ser. 5, vol. vii. p. 154.

I adopt the genus *Diploporella* merely for convenience, as I am not sure whether it should be retained, and there seems to my mind too great a tendency to divide up the Steganoporellidæ, instead of making *Micropora* more comprehensive ; but a more critical study may alter my opinion.

Loc. Queenscliff and Portland, Victoria ; Bondi Bay, N. S. Wales.

33. *Micropora perforata* (MacG.).

Membranipora perforata, MacGillivray, Trans. Phil. Inst. Vict. 1859; Zool. of Victoria, dec. iii. p. 29, pl. xxv. fig. 2.
Micropora perforata, Waters, Quart. Journ. Geol. Soc. vol. xli. p. 290.
Membranipora stenostoma, Busk, Cat. Mar. Polyzoa, p. 60, pl. c. fig. 1.

Sow-and-Pigs Reef, Port Jackson.

34. *Micropora ratoniensis*, sp. nov.
(Pl. IV. fig. 5.)

Zoarium small, articulated, with a longitudinal row of zoœcia on each of the four sides. Zoœcia arranged diagonally, with a minute triangular avicularium by the side of each. A pore on one side below the aperture.

This from its size and general appearance would be placed with *Setosella*, but *Setosella* is described as with vibracula; however, Mr. Hincks (Ann. & Mag. Nat. Hist. ser. 5, vol. vii. p. 155) at first considered *Vincularia abyssicola*, Sm., to belong to *Setosella* ; but surely the organs there are avicularian, and the mandibles have wings like those of *Membranipora angulosa*, Rss., &c. *Setosella Folini*, Jullien (Bull. Soc. Zool. t. vii. 1882, p. 27, pl. xvii. figs. 63–65), is a uniserial free *Setosella*, but is not described as articulated, though, if described from a small fragment, this might not be seen. These two species indicate that the genus *Setosella* will have to be given up.

Cellularia diplodidymioides, Meun. & Pergens (Bry. du Syst. Montien, p. 3) is also apparently somewhat allied.

Loc. Off Raton, New Guinea, 7 fath.

35. *Thalamoporella Rozieri* (Aud.).

Flustra Rozieri, Aud. Descr. de l'Egypte, pl. viii. fig. 9.
Membranipora Rozieri, Busk, Brit. Mus. Cat. p. 59, pl. lxv. fig. 6.
Steganoporella Rozieri, Hincks, Ann. & Mag. Nat. Hist. ser. 5, vol. vi. p. 379, pl. xvi.; Waters, Quart. Journ. Geol. Soc. vol. xxxviii. p. 505.
Eschara ignobilis, Reuss, "Foram. Anth. & Bry. des Septarienthones," Denkschr. Ak. Wissensch. Wien, xxv. p. 181 (65), pl. vi. fig. 14.
Vincularia novæ-hollandiæ, Haswell, "Polyzoa from the Queensland Coast," Proc. Linn. Soc. N. S. Wales, vol. v. pt. i. p. 41, pl. iii. fig. 3.

The zoarium of the Darnley-Island species is always tubular, or, as we may call it, in the *Vincularia*-form. It has neither avicularia nor ovicells, and the "marginal tuberosities" are only occasionally found. The oral aperture is rounded below.

This is undoubtedly the *V. novæ-hollandiæ* of Haswell, but does not seem to be the *Vincularia gothica*, Busk (Challenger Rep. p. 72), which he, however, unites with *novæ-hollandiæ* and with *Vincularia steganoporoides*, Goldstein. This last is larger than the Darnley-Island specimen, and it seems open to doubt whether it should be placed here or with *gothica*.

I still feel doubtful about the Steganoporellidæ, but it seems right to follow Mr. Hincks as long as I have not made an exhaustive study of these families; but in attempting to bring this and the family Microporidæ into order we get very elaborate descriptions of the division of the zoœcium into various chambers. In many cases it seems that it would be simpler to say that the anterior portion is prolonged by a tubular extension; in fact, the chamber for the polypide is flask-shaped, and the end is closed by an operculum. In most cases the operculum is partly attached to the integument which covers the front, but it is usually also attached to the calcareous wall by a small ridge at the side.

Taking fig. *a* as a type, and slightly altering the form of the aperture, making the neck narrower or wider, and placing the pores in different positions in the space formed between the neck and the lateral walls, we shall find that we have a large series of Microporidæ and Steganoporellidæ, and my present opinion is that many things that have been removed from the Microporidæ will have to be brought back there again.

Fig. *a*.

Loc. Living: in different varieties from

India, California, Australia; Holborn Island, Queensland (*H.*); Darnley Island, Torres Straits, 10–30 fath. (*Br.*). Fossil: Miocene of Europe; Bairnsdale, Australia.

36. *Cribrilina monoceros*, Busk, non Reuss.
(Pl. VI. fig. 7.)

The mandible has the lucida very low down, and this position sometimes obtains in *Retepora* and *Flustra*, but it is usually more central. There are two lateral processes as in *Adeonella*, *Membranipora*, &c. The operculum is fleshy and granulate. The chitinous parts of *C. acanthoceros* are very similar.

Loc. Living: S. America; various localities in Victoria; 'Challenger' Station 303, 1325 fath.; Station 235; N. Pacific, 3125 fath.; Station 315, 12 fath.; N. side of Watson's Bay, Port Jackson, "under stones." Fossil: Bairnsdale (Victoria) in *Eschara*-form; Napier, adnate, and Petane (N. Zealand).

37. *Cribrilina tubulifera*, Hincks.
(Pl. V. figs. 2, 6.)

Cribrilina tubulifera, Hincks, Ann. & Mag. Nat. Hist. ser. 5, vol. viii. p. 56, pl. i. fig. 7 (1881); Waters, Quart. Journ. Geol. Soc. vol. xxxix. p. 436.

The specimen from Ball's Head has two rows of erect tubular processes instead of a single one, as described by Hincks, and in this respect resembles the *C. suggerens*, which I described fossil from Curdies Creek about the same time as Mr. Hincks published his species. The aperture of *C. suggerens* is only 0·06 millim. wide, whereas this is 0·14 millim., being larger than the fossil from Muddy Creek, which is only 0·1 millim. wide. The zoœcia of my *C. suggerens* and this specimen of *tubulifera* are the same size.

Loc. Bass's Straits (*H.*); Ball's Head, Port Jackson, 12 fath. Fossil: Muddy Creek, Victoria; and var. *suggerens* from Curdies Creek.

38. *Cribrilina clithridiata*, sp. nov.
(Pl. V. fig. 1; Pl. VI. fig. 2.)

Zoarium incrusting. Zoœcia elongate, ovate, distinct, convex, about half of the front occupied by an oval area divided by radiating lines into six sections, with an elliptical opening at the peripheral end of each, the furrows not punctured. Oral aperture clithridiate, the distal edge rounded and the proximal triangular, with a very considerable contraction on each side about the middle of the aperture, and about this

position the operculum often has little wings. Operculum 0·11 millim. wide. There is one large vicarious avicularium with a spatulate mandible resembling that of *C. philomela*, Busk (Chall. Rep. pl. xxii. fig. 7).

The shape of the aperture is quite unusual in the genus *Cribrilina*, but all the other characters are Cribrilinidan, and some fossils as figured by Reuss seem to have a similar aperture. This is perhaps related to *C. speciosa*, Hincks, and according to Jullien (Bull. Soc. Zool. de France, vol. xi. p. 606) would be *Decurtaria*.

Loc. Sow-and-Pigs Reef, Port Jackson, 3–4 fath. (*Brazier*).

39. *Microporella violacea*, Johnst.

One of two specimens from Bondi Bay is violet, the other white, but this may be bleached. So far as I am aware it has not been described as living near Australia, except by Dr. Pergens, who writes that it was brought by a ship's captain from Australia.

Loc. Living: Europe; Florida; Madeira; Red Sea; Bondi Bay (N. S. Wales). Fossil: Miocene of Söllingen; Pliocene of England, Belgium, Italy, and Rhodes; Australia.

40. *Microporella ciliata*, Pallas.

A specimen from the Sow-and-Pigs Reef has the pore semilunate and an avicularium placed rather high on each side. In having an avicularium on each side, and also in its general form, it resembles *M. ciliata*, var. *californica*, but that form has a round pore filled in with a cribriform plate.

Loc. Sow-and-Pigs Reef, Port Jackson, 3–4 fath.

41. *Microporella decorata*, var. *lata*, MacG.
(Pl. VI. figs. 1, 6.)

Lepralia lunata, MacG. Zool. Vict. dec. iv. p. 27, pl. xxxvi. fig. 8.
Microporella diadema, var. *lata*, MacG. Trans. Roy. Soc. Vict. vol. xxi. p. 112, pl. iv. fig. 5.

The avicularian mandibles are without any lucida, but there is a characteristic cross bar near the base.

Loc. Queenscliff, Victoria (*MacG.*); Port Phillip (*W.*); Ball's Head, 12 fath., and Watson's Bay, Port Jackson.

42. *Microporella Malusii*, Aud.

Loc. Living: Europe; Australia; New Zealand; and South America; Bottle-and-Glass Rock, 8 fath.; Sow-and-Pigs Reef, 3–4 fath.; Green Point, Port Jackson, 8 fath., sandy

mud bottom. Fossil: European Pliocene; Australia; New Zealand.

43. *Microporella tetrastoma*, Rss., var.

Type *Eschara tetrastoma*, Rss. Sitz. Ak. Wien, 1864, vol. l. p. 9, pl. ii. fig. 9.

There is a small fragment of a *Microporella* from Darnley Island, of which the zoarium has consisted of thin flattened foliaceous branches. The pyriform zoœcia have two or sometimes three pores below the oral aperture, and below these a raised boss or umbo.

It does not seem advisable to name so small a fragment, since this group shows great variation in the zoœcia. I have recent *M. tetrastoma* from Port Phillip, with a broad foliaceous growth, in which the outer cells have merely an elongate denticulated pore, whereas the central ones have numerous denticulated pores; on each side of the suboral pore there is a small avicularium directed diagonally upwards; usually the aperture, pore, and avicularia are placed in a deep pit, but this is not always the case, and the central zoœcia are usually larger and more raised.

Microporella tetrastoma is no doubt the *M. clavata* from Curdies Creek (Quart. Journ. Geol. Soc. vol. xxxvii. p. 332), and the *Adeonellopsis parvipuncta*, MacG.

Loc. Darnley Island, Torres Straits, 10–30 fath.

44. *Porina larvalis*, MacG. (Pl. VI. fig. 8.)

Lepralia larvalis, MacGillivray, Nat. Hist. of Vict. dec. iv. p. 30, pl. xxxvii. fig. 5.

Porina larvalis, Waters, Quart. Journ. Geol. Soc. vol. xxxviii. p. 269, pl. viii. fig. 19; MacGillivray, Cat. Mar. Polyzoa of Victoria, p. 27.

As I have already pointed out, the question of the generic position is a difficult one; but as the two large pores open into the throat of the peristome and not below the oral aperture, I placed it with *Porina*, and in this it seems that Mr. MacGillivray agrees.

The mandible is simple with a plain lower edge without articular processes, but there are two characteristic diagonal muscular ridges immediately below the lucida.

Loc. Fossil: (with cylindrical zoarium) Bairnsdale. Recent: Victoria; West Australia; Bondi Bay, N. S. W.

45. *Porina coronata*, Rss. (Pl. VI. fig. 5.)

For synonyms see Waters, Quart. Journ. Geol. Soc. vol. xli. p. 297.

This was described as *coronata* by Reuss, and as *gracilis* by Lamouroux and others, but most of the descriptions were

so unsatisfactory that the species intended was left somewhat doubtful; but as Milne-Edwards described it in more detail it is perhaps a question whether we ought not to call it *gracilis*, Lamx. & Edw.

As I have already pointed out, the opercula of species growing in the *b* or *vertebralis*-form, although slightly smaller, correspond with those from typical "*Eschara gracilis*" growing in a foliaceous manner.

Loc. Fossil: France (Cretaceous); Miocene of Europe; Australia; New Zealand, various localities. Living: in *b*-form, Holborn Island, 20 fath.; Darnley Island, Torres Straits, 10-30 fath.; Cape Grenville, N.E. Australia, 20 fath.

46. *Porina inversa*, sp. nov.
(Pl. IV. fig. 23; Pl. V. fig. 5.)

Zoarium incrusting. Zoœcia indistinct, surface flat with large pores; a perforated protuberance, probably avicularium, at each side of the aperture; a round suboral pore. The oral aperture is straight on the distal edge and rounded on the proximal, with the operculum divided radially by irregular bars of thicker chitin, and an irregular ridge near the distal edge. It will be seen that the shape of the oral aperture, which is directed more or less towards the distal part of the zoarium, is the reverse of the usual shape of *Porina*, and, in fact, of the Bryozoa generally, so that, being peculiar in this respect, it is a question whether a new genus should not be made for it.

The zoœcial characters seem much the same as those of *Myriozoum marionensis*, Busk (Chall. Rep. p. 171, pl. xxiii. fig. 6), and there are two figures (pl. cx. figs. 2, 3) in Busk (Brit. Mar. Polyzoa) which seem to be without any description, and may be allied to the present.

Loc. Sow-and-Pigs Reef, 3–4 fath., and Port Jackson, 10 fath.

47. *Tubucellaria opuntioides*, Pall.
(Pl. V. fig. 10.)

Cellaria opuntioides, Pergens, Plioc. Bry. von Rhodos, p. 12.
Tubucellaria cereoides, MacG. Zool. Vict. dec. xi. p. 18, pl. 105. fig. 2.

There are small fragments from Bondi Bay and Adelaide which have the peristome very much prolonged and then curved inwards. This occurs in the Mediterranean *T. opuntioides* (*cereoides*) and in *T. hirsuta*, and in this last the position of the spines remains constant in relation to the pores and not to the aperture. The prolonged peristome was figured

by Busk for *Onchopora hirsuta* (Quart. Journ. Microsc. Sci. vol. iii. pl. iii. fig. 5), but may occur in all parts of a colony, and is by no means confined to the neighbourhood of a joint.

The specimens from Bondi Bay, Adelaide, and Darnley Island are all more delicate than those from Naples, but the sculpturing is the same, and, so far as these small fragments enable me to form an opinion, I do not see any reason for separating them. Both Prof. MacGillivray's figure from Port Phillip Heads, and a specimen sent to me as *Onchopora tubulosa*, Busk, from Tasmania, agree with those from Naples; the same seems to be the case with the *Tubucellaria opuntioides* of the 'Challenger' Report, from St. Paul's Rocks, N. Atlantic; and I do not understand why Mr. Busk separates this from the Mediterranean form.

Loc. Fossil: Eocene; Miocene; Pliocene of Europe, various localities. Living: Mediterranean; Madeira; Tasmania; N. Atlantic; Victoria; Adelaide; Bondi Bay, N. S. W.; Darnley Island, Torres Straits, 10–30 fath.

48. *Schizoporella marsupifera*, Busk.

Schizoporella marsupifera, Busk, 'Challenger' Report on the Polyzoa, pt. xxx. p. 165, pl. xxii. fig. 14; Waters, Quart. Journ. Geol. Soc. vol. xliii. p. 65; Hincks, Ann. & Mag. Nat. Hist. ser. 5, vol. xix. p. 315.

Schizoporella lineolifera, Hincks, Ann. & Mag. Nat. Hist. ser. 5, vol. xvii. p. 267, pl. ix. fig. 10.

The Port Jackson specimen is without any ovicells, and no spines are apparent. The surface-pores, which are numerous, are elongate, with the longer axis usually pointing towards the oral aperture. Mr. Hincks speaks of the pores being stellate, which is not the case in the Australian specimen, and Mr. Busk calls the surface granular, so that it seems to be subject to considerable variation. Operculum granular.

Loc. Fossil: Waipukurau (N. Zealand). Living: Marion Island, 50–75 fath.; New Zealand; Adriatic; Bottle-and-Glass Rocks, Port Jackson, 8 fath.

49. *Schizoporella triangula*, Hincks.
(Pl. VI. fig. 3.)

Schizoporella triangula, Hincks, Ann. & Mag. Nat. Hist. ser. 5, vol. viii. p. 60, pl. ii. figs. 4, 4*a*; Busk, Rep. Chall. Polyzoa, p. 167.

A specimen from Port Jackson is small and only composed of young cells, which are merely punctured without being nodulated; but this is also the case in the young cells of a fine specimen from Port Western, in which the older cells show the usual structure of the species. In old cells the

avicularian chamber is often much raised, looking like an ovicell.

Loc. Bass's Straits, 38 fath.; Heard Island? (*B.*), 75 fath.; Port Western, Melbourne (*W.*); Sow-and-Pigs Reef, Port Jackson, 3–4 fath.; Semaphore, Adelaide (*W.*).

50. *Schizoporella tuberosa* (Rss.).
(Pl. VI. figs. 9 & 10.)

Eschara tuberosa, Rss. Denkschr. Ak. Wien, vol. xxv. p. 188, pl. vi. figs. 9, 10, pl. viii. fig. 1.
Schizoporella biturrita, Hincks, Ann. & Mag. Nat. Hist. ser. 5, vol. xiv. p. 280, pl. ix. fig. 8; see also ibid. vol. xvii. p. 269.
Gephyrophora polymorpha, Busk, 'Challenger' Rep. p. 167, pl. xxxiv. fig. 2.
Schizoporella tuberosa, Waters, Quart. Journ. Geol. Soc. vol. xliii. p. 67, pl. viii. fig. 29.

This is interesting for the great variability to which the avicularia are subject; in what we may call the most normal form there is a tower on each side of the oral aperture, and the avicularium is placed on the side directed away from the aperture; but sometimes, on the same colony, the towers bear no avicularia, but have a small round opening on the summit. In some cases the avicularian chamber is not so much raised, and then the mandibular opening is directed towards the distal end of the colony. I do not possess any specimens with the avicularia arching over the mouth, but in the Zürich Museum there is a fine one from Cape Agulhas (S. Africa) showing the arching just as figured by Mr. Busk. Possibly *Reptescharellina cornuta*, Gabb & Horn, is this species, though it may be *S. biaperta*.

The attachment is by irregular elongated or tubular projections. A variety described as var. *angustata* occurs fossil in New Zealand.

Loc. Port Phillip Heads (bilaminate); Semaphore, Adelaide (Hemescharan); Cape Agulhas &c., S. Africa; Bondi Bay, N. S. Wales; Botany Bay (Lepralian), and Inner North Head, Port Jackson, 8 fath. (Hemescharan).

51. *Schizoporella Ridleyi*, MacG.

For synonyms, see Waters, Quart. Journ. Geol. Soc. vol. xliii. p. 64.

Loc. Elizabeth Island, 6 fath. (*R.*); Victoria (*MacG.*); Sow-and-Pigs Reef, 3–4 fath., Port Jackson. Fossil: Waipukurau and Napier (?), New Zealand.

52. *Schizoporella confinita*, Waters, var. *ratoniensis*.

There are only small pieces of narrow compressed branches

dichotomizing at a very acute angle. The oral aperture is round, with the sinus a trifle more distinct than in the other two varieties, and this has led me to change the generic position. The surface is studded with large nodules considerably raised and there are small round avicularia, usually one to each zoœcium. One fragment certainly seems to have been articulated, as at the base there are numerous large holes resembling those at the base of an internode of *Cellaria*.

Loc. Off Raton, New Guinea, 7 fath.; Cape Grenville, N.E. Australia, 20 fath. (both dredged by *Brazier*).

53. *Schizoporella confinita*, Waters, var. *piperiensis*, var. nov.

Type *Lepralia confinita*, Waters, Quart. Journ. Geol. Soc. vol. xli. p. 299, pl. vii. fig. 10.

There is a flat bilaminate fragment from Piper Island, with the aperture about 0·12 millim. The surface is covered with numerous dome-shaped elevations with a round avicularian mandible at one side.

With a species like the present it is difficult to know from the aperture whether the lateral denticles form a sinus, or whether the operculum is entire. From the recent specimen I now think that it should be placed under *Schizoporella*.

Loc. Piper Island, N.E. Australia, 9 fath.

54. *Schizoporella divisopora*, sp. nov.
(Pl. V. fig. 4; Pl. VI. fig. 4.)

Zoarium incrusting. Zoœcia distinct, ovate, raised, vitreous in young cells, the surface occupied with large stelliform pores, which are separated into four or more divisions by cross bars. Oral aperture emarginate, the sinus being large, rounded. Ovicell raised, surrounded by a thick rim, inside which are a row of pores, the centre of the ovicell raised into a prominent umbo.

The pores in *M. Malusii* are smaller and usually dentate, as the teeth do not meet in the centre. Stellate pores occur in several cases in *Microporella*, but I am not aware of any case in which they have previously been found in *Schizoporella*.

This may be allied to *Schizoporella Maplestonei*, MacG. (Zool. Vict. dec. iv. p. 24, pl. xxxv. fig. 7), and to *Lepralia grossipora*, Rss. (in plate *crassipora*), Bry. Œst.-Ung. p. 177 pl. vii. fig. 6.

Loc. Off the Bottle-and-Glass Rocks, Port Jackson, 8 fath., rocky bottom, and Sow-and-Pigs Reef, 3–4 fath., Port Jackson, N. S. Wales.

55. *Lepralia elimata*, sp. nov.
(Pl. V. fig. 3; Pl. VI. fig. 22.)

Zoarium incrusting. Zoœcia indistinct, or divided by a deep depression, surface smooth, porcellaneous, frequently a large raised avicularium below the aperture directed forwards, closed by a large round mandible. The oral aperture is coarctate, with a denticle on each side forming the contraction. Opercula 0·13 millim. wide. The ovicell is smooth, plain, subimmersed, widely open in front. This in many respects much resembles *L. hippopus*, but has only the central suboral avicularium and no lateral ones.

The well-marked thickened lateral bands on the sides of the opercula seem to be the rule in true *Lepralia*, and it may be found to be a character of generic value. It occurs in *L. adpressa*, *L. Pallasiana*, *L. Poissonii*, *L. rectilineata*, *L. striatula*, &c., and may be seen in my figure of the operculum of *L. rectilineata* (Quart. Journ. Geol. Soc. vol. xliii. pl. viii. fig. 34).

Loc. Sow-and-Pigs Reef, Port Jackson, 3–4 fath.

56. *Lepralia vestita*, Hincks. (Pl. VI. fig. 21.)

Lepralia vestita, Hincks, Ann. & Mag. Nat. Hist. ser. 5, vol. xv. p. 256, pl. ix. fig. 9.

Specimens from Port Jackson have somewhat larger zoœcia than those from Tahiti, the oral aperture is also a trifle larger, and there are no avicularia. The upper part of the thick peristome is raised; the large prominent ovicell is usually thickened at the two sides, where it joins the peristome, forming a kind of raised ridge, and the centre is sometimes umbonated. The operculum has two thick lateral bands, and in the oral aperture there is a denticular contraction at each side.

Loc. Tahiti; Fiji Island; Sow-and-Pigs Reef, Port Jackson, 3–4 fath. (dredged by *Brazier*).

57. *Mucronella Ellerii*, MacG., var. *biaviculata*, nov.
(Pl. V. fig. 9.)

Type *Lepralia Ellerii*, MacG. Trans. Roy. Soc. Vict. vol. ix. 1868, p. 135; Zool. Victoria, dec. iv. p. 31, pl. xxxvii. fig. 8.

A specimen from Green Point, growing on *Idmonea Milneana*, has the rostrum much prolonged with a triangular avicularium on one side, and often on the prolongation of the rostrum a small semicircular avicularium. There are six spines above the aperture, the finely granulated ovicell is

narrower than in typical *M. Ellerii*, and there are no spinous processes. Oral aperture 0·25 millim.

In the shape of the avicularian mandible this most nearly approaches *M. vultur*, Hincks (see Zool. Vict. dec. xii. p. 65, pl. cxvi. figs. 5–8), but this I should only consider a variety. *M. porosa*, Hincks, also seems only to be another variety, and occurs from Port Western, Victoria, with the small rounded avicularium on the margin at one side of the mucro, entirely corresponding with Mr. Hincks's figure.

I have also described (Quart. Journ. Geol. Soc. vol. xxxviii. p. 512) a fossil from Curdies Creek, in which there are spinous processes, as in *M. Ellerii*, with an avicularian chamber at the top, and such spinous processes seem to be readily transformed into avicularia.

We thus seem to have four varieties :—

Mucronella Ellerii, MacG., *typica*, from Williamstown and Warrnamboul, Victoria (*MacG.*) ; Port Phillip, Vict. (*A. W. W.*) ; Tasmania (*A. W. W.*).

Var. *porosa*, H., Curtis Island (*H.*); Port Western (*A. W. W.*). (Pl. VI. figs. 12, 17.)

Var. *vultur*, H., Port Phillip Heads, Portland, and Warrnamboul.

Var. *biaviculata*, Waters, Green Point, Port Jackson, 8 fath.

58. *Smittia Landsborovii*, Johnst., form *personata*, H.
(Pl. VI. fig. 23.)

Smittia Landsborovii, Johnst. form *personata*, Hincks, Ann. & Mag. Nat. Hist. ser. 5, vol. xiv. p. 283, pl. ix. fig. 3.

Smittia Landsborovii, Johnst., var. *purpurea*, Hincks, ibid. vol. viii. p. 64.

Smittia Jacobensis, Busk, Rep. 'Challenger,' Polyzoa, p. 153, pl. xix. fig. 7.

Some large specimens growing over *Mesenteripora repens*, Haswell, are deep purple, and in some parts of the colony the arching over of the peristome is frequent, but in others is not seen. Sometimes enormous spathulate avicularia cover the whole of the zoœcium. The immersed ovicell has an oval perforated area.

Loc. Living: Bass's Straits (*H.*); Port Phillip Heads (*H.*); Porto Praya, Cape Verd Islands, 100–200 fath.; Marion Island 50–75 fath. (*B.*); N. of Watson's Bay, Port Jackson, under stones.

59. *Rhynchopora crenulata*, sp. nov.
(Pl. V. figs. 7, 8.)

Zoarium incrusting. Zoœcia ovate, depressed below, sur-

face smooth, with a spinous umbo below the aperture bearing an avicularium (apparently semicircular) on the inner face; four spines above the oral aperture. In the central zoœcia also an erect avicularium with slit-like aperture. Oral aperture (0·1 millim. wide) nearly round, contracted by two lateral denticles near the lower part. Ovicell immersed, with the front flat.

The oral aperture in a case like this might be considered either Schizoporellidan or Lepralian. The outer zoœcia are decumbent and the inner erect, resembling *Rhynchopora bispinosa* in this respect; and in these two species the distal edge of the oral aperture is crenulated, which is not usual in the Bryozoa; but I have also seen the same thing in the growing cells of a *Smittia*.

This differs from *R. longirostris* in the surface avicularia being shorter and erect instead of decumbent; there are no perforations round the border of the zoœcia, and the aperture with its denticles is different.

Loc. Living: Ball's Head, Port Jackson, 12 fath.

60. *Rhynchopora profunda*, MacG.
(Pl. VI. fig. 11, 16.)

Rhynchopora profunda, MacGillivray, "Descriptions," &c. pt. iii., Trans. Roy. Soc. Victoria, vol. xix. p. 192, pl. ii. fig. 8.

In the specimens from Noumea there is a broad plate or denticle directed inwards from the proximal edge of the aperture, and the "unciform process" is very large and distinct. These are the main characters on which it is separated from *R. bispinosa*; but, besides, the operculum enables it to be distinguished, as the lower sinal curve is much broader and the muscular impressions are at the side, whereas in *R. bispinosa* the muscles are attached to two bosses on the surface of the operculum, as in *S. Cecilii* &c. The upper border of the operculum when seen from above appears to be nodulated; but when seen laterally these nodulations are found to be small teeth corresponding with the dentate border of the aperture. This last structure also obtains in what I consider *R. bispinosa* from Australia, but there the operculum is granulated and has the muscular impressions in the usual position.

This nodulated or dentate structure is found in many semicircular avicularian mandibles, and is known in two or three opercula, but is not common.

Loc. Port Phillip Heads; Noumea, New Caledonia, 5 fath.

61. *Retepora phœnicea*, Busk. (Pl. VI. figs. 15, 20.)

Retepora phœnicea, Busk, Brit. Mus. Cat. p. 94, pl. cxxi. figs. 1, 2; Hincks, Ann. & Mag. Nat. Hist. ser. 5, vol. i. p. 362; MacGillivray, Zool. Vict. dec. x. p. 27, pl. 98. figs. 1–5, and pl. 94. fig. 13; Busk, 'Challenger' Rep. p. 124, fig. 34.

The front of the zoœcium has numerous large foramina, the dorsal surface is divided by prominent vibicæ, and in each division there are from one to four small foramina.

There seems to be some mistake with Busk's figure of the operculum, as it does not correspond with any that I have seen. The mandible is without a lucida.

This is evidently common, and Mr. Brazier speaks of its being known by his children as the "red coral."

Loc. Living: Bass's Straits, 38 fath.; Victoria; South Australia; off Bottle-and-Glass Rocks, Port Jackson, 8 fath., rocky bottom; and Vaucluse Point, Port Jackson, 5 fath.

62. *Retepora formosa*, MacG.

Retepora formosa, MacGillivray, New or Little-known Polyzoa, pt. v. Trans. Roy. Soc. Vict. vol. xx. p. 109, pl. ii. fig. 6, and pl. iii. fig. 6; Zool. Vict. dec. x. p. 24, pl. xcvii. figs. 4–6, and pl. xciv. fig. 6.

A small fragment, from which I have been unable to make any preparation, from Bondi Bay, near Sydney.

Loc. Port Phillip Heads, 10–18 fath.

63. *Cellepora albirostris*, Smitt.

Loc. Fossil: River Murray (Austr.); Napier and Wanganui (N. Zealand). Living: Florida; Sydney; Heard Island; Victoria; Shark Island, Port Jackson, 8 fath.

64. *Cellepora mamillata*, Busk.

Cellepora mamillata, Busk, Brit. Mus. Cat. p. 87, pl. cxx. figs. 3–5; Ridley, Proc. Zool. Soc. 1881, p. 54; Waters, Quart. Journ. Geol. Soc. vol. xli. p. 304.

Cellepora mamillata, var. *atlantica*, Busk, Chall. Rep. Polyzoa, p. 199, pl. xxxv. figs. 4, 5, 13.

A specimen from Ball's Head is submassive, some inches across, formed of several layers. The avicularia are often raised as erect tubular chimneys, and the avicularian bar has a minute ligula and the mandible a columella. The smooth round ovicell is scarcely at all raised.

Loc. Fossil: River Murray Cliffs. Living: Patagonia; Brazil; Bahia; New Zealand (*Hutton*); Victoria (*MacG.*); Ball's Head, Port Jackson, 12 fath.; and north side of Watson's Bay, Port Jackson, "found under stones at low water."

65. *Cellepora bispinata*, Busk.

Cellepora bispinata, Busk, Brit. Mus. Cat. p. 87, pl. cxx. figs. 1, 2.

A specimen from the mouth of the Lane-Cove River, Port Jackson, growing on *Amathia*, seems to be this species. It has the spines articulated, as figured by Busk, and the operculum is light-coloured. The ovicell, which was not described by Busk, is globular, granular, arching over the oral aperture, and widely open in front, being very similar to that of *C. ovoidea*, Aud. The mandibles of the small rostral avicularia are semicircular, and in one specimen there are also a few spatulate vicarious avicularia, but I cannot find any in the other specimens.

This in many respects is very closely allied to *C. albirostris*, Sm., but is distinguished by the articulated spines, and the operculum is not distinctly indented at the side, although the chitinous band shows a tendency in this direction, and in this respect resembles that of *C. mamillata*.

Loc. Tasmania (*B.*); Victoria (*MacG.*); New Zealand (*Hutton*); mouth of Lane-Cove River, 7 fath., rocky bottom.

66. *Cellepora granum*, Hincks.

Cellepora granum, Hincks, Ann. & Mag. Nat. Hist. ser. 5, vol. viii. p. 68, pl. iii. fig. 8; Waters, Quart. Journ. Geol. Soc. vol. xxxix. p. 440, pl. xii. fig. 18.
Cellepora Boryi, Waters, Ann. & Mag. Nat. Hist. ser. 5, vol. iii. p. 195.
Lagenipora nitens, MacG., "Descriptions," pt. xii., Trans. Roy. Soc. Vict. 1886, p. 2 (sep.), pl. i. fig. 1.

There is a small specimen from Green Point, growing on *Mucronella Ellerii*, forming a small radiate colony, with thin semitransparent walls, so that the avicularian chamber can be traced as figured by MacGillivray in *L. nitens*, but where the growth is more solid this cannot be done. The bulging ovicells at the side have the characteristic flat surface with radiating pores.

I do not doubt that this is specifically identical with a specimen in my collection from Naples, which I consider to be *C. Boryi*, and also with a specimen sent me as *C. granum* from New Zealand, and another sent as *L. nitens* from Port Phillip.

I have, however, taken Mr. Hincks's name, seeing that *C. Boryi*, Aud., *C. Costazii*, Aud., and *C. Protainii*, Aud., may be varieties of the same thing, with which, at any rate, *C. granum* must be closely allied. It is further closely allied to *Lagenipora spinulosa*, H. (probably *C. bicornis* of the 'Challenger' Report), and *Phylactella lucida*, H.

Loc. Fossil: Victoria. Living: Curtis Island (*H.*); Naples; Port Phillip Heads (*MacG.*); New Zealand; and Green Point, Port Jackson, 8 fath. (sent by *Brazier*).

67. *Cellepora ovoidea* (Aud.). (Pl. VI. figs. 14, 19.)

Cellepora ovoidea, Aud. Descr. de l'Egypte, pl. viii. fig. 7.

Zoarium irregularly lobed, forming a mass about 2 centim. across; has started on a small stalk of seaweed. Zoœcia with a few pores, a prominent rostrum without avicularia below the mouth. Operculum slightly convex on the lower edge, and somewhat broader below, but not usually so much as in the figure. Between the zoœcia there are large, spatulate, vicarious avicularia, and there is a moderate-sized lucida about the middle of the mandible; there is no columella, and the lower edge is straight.

The ovicell is globular and smooth, usually surmounted by a mucro which sometimes is considerably raised. The ovicell is widely open in front, and projects over the aperture of the raised zoœcia.

There is also *C. ovoidea*, Lamx., but the figure and description are not sufficient to enable it to be recognized.

Loc. Vaucluse Point, Port Jackson, 5 fath.

68. *Conescharellina incisa* (Hincks). (Pl. VI. fig. 26.)

Lunulites incisa, Hincks, Ann. & Mag. Nat. Hist. ser. 5, vol. viii. p. 68, pl. iv. figs. 1–3.

Conescharellina conica, Haswell, Proc. Linn. Soc. N. S. Wales, vol. v. pt. i., 1880, p. 42, pl. iii. figs. 7, 8.

Hincks and Haswell both described this about the same time, and it is not clear which had priority; but as there is *Batopora conica*, Seguenza, and *Lunulites conica*, Defr., it would seem necessary to drop that name.

An important avicularian character has been overlooked by both Haswell and Hincks, namely, that on the cross bar, besides the central ligula, there is a smaller one on each side. The zoœcial chamber is long, and there is a straight row of about eight rosette-plates along the edge of the wall.

This may be *Lunulites angulopora*, T. Woods, but apparently the avicularia were mistaken for the zoœcial cells, and the zoœcia for vibracula.

Loc. Holborn Island; Bass's Straits; Port Stephens, 25 fathoms, "sandy mud bottom"; N.E. coast of Australia, 23 fathoms (these latter sent by Mr. Brazier are smaller than the others).

69. *Conescharellina elegans* (d'Orb.).
(Pl. V. figs. 13–17.)

Flabellopora elegans, d'Orb. Pal. Fr. p. 53, pl. 661. figs. 1–5.

In some of the specimens the flabelliform zoarium is formed of two contiguous layers back to back; others have between the layers a cancellous structure with numerous large openings, between which are small round avicularia. The zoœcia are similar to those of *C. cancellata*, also with small round avicularia between them, but the zoœcium is larger, and the oral aperture measures 0·1 millim. instead of 0·08 millim., as in *C. cancellata*.

Loc. Ouantang and Hainau (China seas), 20 met. (*d'Orb.*); Port Stephens, 7–8 fath. (dredged by *Brazier*).

70. *Conescharellina cancellata* (Busk).
(Pl. IV. fig. 24; Pl. VI. figs. 13, 18.)

Lunulites cancellata, Busk, Brit. Mus. Cat. p. 101, pl. cxiii. figs. 4–7; Waters, Q. J. Geol. Soc. vol. xxxvii. p. 344, vol. xxxviii. p. 275.
Lunulites cancellatus, Waters, ibid. vol. xxxviii. p. 512, pl. xxii. figs. 10, 11.

On the upper surface there are numerous small round avicularia irregularly placed, and the under cancellated surface is formed of round cells with small round avicularian openings similar to those on the upper surface. All my specimens have these round avicularia, and they are also very distinct in the British-Museum specimen; but Mr. Busk does not seem to have correctly appreciated them, as his *Lunulites* is defined as having vibracula, and his *Conescharellina* as having avicularia.

The peristome has a slit on the proximal edge, and the operculum is oval. The avicularian mandible has the lucida in the centre.

The dorsal surface of *C. incisa* is very similar to that of this species, but I am unable to see that the round openings had any mandibular covers, whereas these are universal in *C. cancellata*.

Although this seems to be abundant from some parts of Australia, it is not mentioned by MacGillivray as occurring off Victoria.

Loc. Philippine Islands (*B.*); Raton, New Guinea, 7 fath.; Darnley Island, Torres Straits, 10–30 fath.; Princess-Charlotte Bay, N.E. Australia, 13 fath.; Port Stephens, from weeds on sandy mud bottom, 5–6 fath. (all dredged by *Brazier*). Fossil: Curdies Creek, Vict.; Mt. Gambier, S. Austr.; Bairnsdale, Gippsland.

71. *Selenaria concinna*, Woods. (Pl. V. fig. 11.)

Selenaria concinna, Tenison Woods, "Australian Selenariadæ," Trans. Phil. Soc. Adelaide, 1880, vol. iii. p. 10, pl. ii. fig. 11.

The vibracular chamber is elongate, with a row of large pores round the border; above it there is a small tubular projection, and in the zoœcium above there is a semicircular hollow. The oral aperture is 0·16 millim. wide.

The central zoœcia are partly closed, in a similar way to those of *Lunulites petaloides*, d'Orb., as described from Muddy Creek (Q. J. Geol. Soc. vol. xxxix. p. 442, pl. xii. fig. 11).

This has only been known fossil previously.

Loc. Fossil: Muddy Creek (Victoria). Living: off Port Stephens, 25 fath. (*Brazier*).

72. *Selenaria maculata*, Busk.

Selenaria maculata, Busk, Cat. Mar. Pol. p. 101, pl. cxvii.; Waters, Quart. J. Geol. Soc. vol. xxxix. p. 440, pl. xii. figs. 7, 9, 12; id. ib. vol. xli. p. 309; Haswell, Polyzoa from the Queensland Coast, p. 42.

Loc. Living: Holborn Island; Barnard Island, N.E. Australia, 10 fathoms (dredged by *Brazier*). Fossil: Muddy Creek and Bird Rock (Victoria); River-Murray Cliffs (S. Australia).

73. *Selenaria punctata*, T. Woods.

Selenaria punctata, Tenison Woods, Trans. Phil. Soc. Adelaide, vol. iii. 1880, p. 9, pl. ii. fig. 8; Waters, Q. J. Geol. Soc. vol. xxxix. p. 440.
Selenaria fenestrata, Haswell, "On some Polyzoa from the Queensland Coast," Proc. Linn. Soc. N. S. Wales, vol. v. pt. i. 1880, p. 42.

This differs from *Selenaria maculata* in the presence of two large pores on the wall of each cell, and the vibracular chamber has a cribriform calcareous cover with much smaller pores than those of *S. maculata*. The pores on the front of the zoœcium are sometimes denticulated, but this is not so distinct in the recent as in the fossil specimens.

Oral aperture: Princess-Charlotte Bay, 0·09 millim. wide; Port Stephens, 0·14. The fossil has an aperture nearly double this size.

Loc. Living: off Cape Three Points, 71 fath. (*Woods*); Holborn Island (*H.*); Princess Charlotte Bay, 13 fath. (N.E. Australia, *Brazier*); off Port Stephens, N.S.W., 25 fath., sandy mud bottom (*Br.*). Fossil: Muddy Creek.

74. *Cupularia canariensis*, Busk.

Cupularia canariensis, Busk, Q. J. Micr. Soc. vol. vii. p. 66, pl. xxiii. figs. 6–9; Crag Polyzoa, p. 87, pl. xiii. fig. 2; Manzoni, Foss. Ital. cont. 1ma, p. 10, pl. ii. fig. 17; Bri. foss. del Mioc. d'Aust. ed Ungh.

p. 24, pl. xvii. fig. 56; Waters, Q. J. G. S. vol. xli. p. 308; Pergens, "Plioc. Bry. von Rhodos," Ann. k.-k. Hofmus. vol. ii. 1887, p. 31.

Membranipora canariensis, Smitt, Floridan Bry. pt. 2, p. 10, pl. ii. figs. 69–71.

Cupularia guineensis, Busk, Brit. Mus. Cat. p. 98, pl. cxiv.; 'Challenger' Rep. p. 206, pl. xiv. fig. 6.

As I have previously shown in one specimen from Princess Charlotte Bay, the sulcate structure of the under surface is very marked; but upon careful examination faint cross divisions can also be distinguished, thus separating the dorsal surface into zoœcial divisions. A few of the central zoœcia are closed by a calcareous lamina, perforated round the border, as figured by Manzoni in *C. Haidingeri*, Rss. (Bri. foss. del Mioc. d'Aust. &c. pl. xvi. fig. 54).

Pergens agrees that I am probably right in uniting both *guineensis* and *stellata* with *canariensis*, and thinks that it is perhaps identical with *C. Haidingeri*.

Loc. Living: Canaries; Madeira; Florida, 10–44 fath.; New Guinea; Torres Straits; Philippine Islands; Princess Charlotte Bay, N.E. Australia, 13 fath. Fossil: Miocene and Pliocene of Europe, numerous localities; Aldinga, S. Australia.

EXPLANATION OF THE PLATES.

Plate V.

Fig. 1. *Cribrilina clithridiata*, sp. nov., × 25.
Fig. 2. *Cribrilina tubulifera*, Hincks, × 50.
Fig. 3. *Lepralia elimata*, sp. nov., × 25.
Fig. 4. *Schizoporella divisopora*, sp. nov., × 25.
Fig. 5. *Porina inversa*, sp. nov., × 25.
Fig. 6. *Cribrilina tubulifera*, H., × 25.
Fig. 7. Avicularium of *Rhynchopora crenulata*, sp. nov., × 85.
Fig. 8. *Rhynchopora crenulata*, sp. nov., × 25.
Fig. 9. *Mucronella Ellerii*, MacG., var. *biaviculata*, nov., × 25.
Fig. 10. *Tubucellaria opuntioides*, Pall., × 25.
Fig. 11. *Selenaria concinna*, T. Woods, × 25.
Fig. 12. *Membranipora tripunctata*, Waters, × 25.
Fig. 13. *Conescharellina elegans* (d'Orb.), × 25.
Figs. 14–17. *Conescharellina elegans* (d'Orb.), natural size. 14. Flat specimen seen laterally. 15. Ditto, sp. seen diagonally. 16. Ditto, upper surface of thick specimen. 17. Ditto, upper surface of thin specimen.
Fig. 18. *Membranipora tripunctata*, Waters, natural size.
Fig. 19. Avicularian mandible of ditto, × 250.
Fig. 20. Mandible of vicarious avicularium of ditto, × 85.

Plate VI.

Fig. 1. Operculum of *Microporella decorata*, var. *lata*, MacG., × 85.
Fig. 2. Operculum of *Cribrilina clithridiata*, sp. nov., × 85.
Fig. 3. Operculum of *Schizoporella triangula*, H., × 85.
Fig. 4. Operculum of *Schizoporella divisopora*, sp. nov., × 85.

Fig. 5. Operculum of *Porina coronata*, Rss., × 85.
Fig. 6. Mandible of *Microporella decorata*, var. *lata*, MacG., × 250. *a* × 85.
Fig. 7. Mandible of *Cribrilina monoceros*, B., × 85.
Fig. 8. Mandible of *Porina larvalis*, MacG., × 85.
Fig. 9. Mandible of *Schizoporella tuberosa* (Rss.), × 85.
Fig. 10. Operculum of ditto, × 85.
Fig. 11. Operculum of *Rhynchopora profunda*, MacG., × 85.
Fig. 12. Operculum of *Mucronella Ellerii*, var. *porosa*, H., × 85.
Fig. 13. Operculum of *Conescharellina cancellata* (B.), × 85.
Fig. 14. Operculum of *Cellepora ovoidea* (Aud.), × 85.
Fig. 15. Operculum of *Retepora phœnicea*, B., × 85.
Fig. 16. Mandible of *Rhynchopora profunda*, MacG., × 250. *a* × 85.
Fig. 17. Mandible of *Mucronella Ellerii*, var. *porosa*, H., × 85.
Fig. 18. Mandible of *Conescharellina cancellata* (B.), × 250. *a* × 85.
Fig. 19. Mandible of *Cellepora ovoidea* (Aud.), × 85.
Fig. 20. Mandible of *Retepora phœnicea*, × 85.
Fig. 21. Operculum of *Lepralia vestita*, sp. nov., × 85.
Fig. 22. Operculum of *Lepralia elimata*, sp. nov., × 85.
Fig. 23. Mandible of *Smittia Landsborovii*, var., × 250. *a* × 85.
Fig. 24. *Discotubigera* (?) *lineata*, MacG., natural size.
Fig. 25. *Amathia biseriata*, Krauss, × 16, showing radicle.
Fig. 26. Avicularium and oral aperture of *Conescharellina incisa* (H.), × 25.
Fig. 27. *Idmonea radians*, showing plates in the side of the ovicell, × 25.
Fig. 28. Plate of ditto, × 85.
Fig. 29. *Idmonea interjuncta*, MacG., × 16.

XXI.—Polyparium ambulans, *a new Cœlenterate.*

By Dr. A. Korotneff *.

[Plate XIII.]

Among the truly singular forms of animals two different types are to be distinguished:—1. The one type appears to be peculiar and interesting as a transition-form between two different classes of animals, and such a form is *Ctenoplana Kowalevskii*, which I have described; 2. The other type fixes the attention of the observer in quite another respect—it is an aberrant form which from various causes has separated itself from its ancestors and taken up an exclusive position in the animal kingdom. If at the same time the intermediate forms have disappeared it only remains for the naturalist to describe this form—he can hardly reckon upon giving it a certain taxonomic position. Such an exclusive aberrant creature is *Polyparium ambulans*, of which I give the description in the following pages.

* Extracted from an article entitled "Zwei neue Cœlenteraten," in the 'Zeitschrift für wissenschaftliche Zoologie,' Band xlv. pp. 468–486. Prof. Ehlers has put forward a different interpretation of the facts recorded by the author; a translation of his remarks will be given in a future number of this journal.

In a preliminary communication * I have already stated that during my voyage to Malaysia I visited the channel between the large island of Billiton and the smaller neighbouring island of Mindanao lying to the west of the former. This locality was particularly recommended to me by my learned friend Dr. Sluiter, of Batavia, and with the greatest justice. While the neighbourhood of the islands to the eastward, between Billiton and the neighbouring islands (Pulu Soukun and Pulu Besar), and thence southwards into the bay near Dindang, presents nothing remarkable, and therefore does not appear especially to be recommended, we must say the direct contrary of the Strait of Mindanao. By the kindness of the Resident of Billiton, M. Zyip, I obtained for a fortnight the use of a large vessel with a Malay crew of seven men. During this time I dredged continually, and I have never seen so many different forms, especially of Echinida and Holothurida; many Ascidia and Corals also occurred, and among the latter I found the animal now under consideration, *Polyparium ambulans*. Once, as I was examining the booty brought up by the dredge, I found a yellowish-grey slimy mass, the size of a chestnut, which consisted of spiral convolutions and was beset with small tubercles. When I isolated this body in a glass vessel I soon saw that the convolutions separated and the mass spread into a band-like, rather thick body, while the tubercles became small, mouth-like apertures, and the whole body, to my great astonishment, extended itself and began to creep slowly upon the bottom of the vessel.

When I turned the animal, or, more properly speaking, the colony, so that the tuberculiferous back was downwards and the creeping sole upwards, I found to my surprise that the whole sole was covered with small acetabula; thus it appeared that the movement, the creeping of the colony, results from the action of the acetabula. By a careful observation of the creature I arrived at the following results. It is a band-like body (Pl. XIII. fig. 1), 7 centim. in length, with a breadth of about 2·5 millim. and a thickness of perhaps ·8 millim.; the anterior and posterior extremities are exactly alike, and rather pointed than rounded off. The lateral margins of the colony are different in this way, that one of them is strongly marked and bordered, so that it forms a very perceptible boundary between the back and the sole, while the other has no border; but here the back is rounded and cylindrical, and passes immediately over into the sole. Upon

* Zool. Anzeiger, no. 223 (1886).

this latter cylindrical margin, as also along the whole back of the colony, are placed conical, chimney-like tubercles (buccal cones, as we shall see hereafter), which are rather scantily distributed, but become more and more crowded together towards the bordered margin, along which they form a regular palissade.

Counted transversely the number of the buccal cones is from four to six; in the longitudinal direction we do not recognize any serial arrangement of them, and they show no particular regularity. The breadth of each cone at the base is 1 millim.; the height varies according to the state in which the buccal cones may happen to be; when contracted they are not more than 1 millim., but when drawn out they measure twice as much. At the apical pole of each mouth-tubercle there is an aperture. But the most remarkable thing is their entire want of tentacles; neither the margin of the aperture itself nor its vicinity bears tentacles or any structures which might be homologous with tentacles.

The inferior surface by which the colony adheres to various objects (fig. 1) is, as already stated, covered with acetabula, and further traversed by two furrows running along the whole colony in such a way that we can distinguish an intermediate area and two lateral streaks; the median area is twice as broad as the lateral streaks, and of the latter the one the margin of which is bordered is band-like, while the other, without a border, is rounded off and passes directly into the dorsal surface. The median area, in a transverse direction, has from two to four rows of acetabula, the lateral streaks only two. The position of the acetabula seems not to be regular, although in certain parts of the sole they appear to be arranged in longitudinal rows; perhaps the appearance observed after the death of the animal may be due to processes of contraction. The interspaces between the acetabula are not quite flat, but they possess transverse folds which, in the living colony, are scarcely noticeable, but make their appearance rather strongly after the action of alcohol.

As regards the individual acetabula, each of them forms a button ·8 millim. in breadth, with a flattened, somewhat notched surface. The size of the acetabula varies very considerably.

The internal structure of *Polyparium* is not less singular than its exterior. The best mode of acquiring a knowledge of the internal organization consists in cutting a piece out of the whole colony by transverse sections, and then dividing this into vertical sections parallel to the longitudinal axis; sections made in other directions are not particularly instruc-

tive and can hardly be orientated. A section made as above described is shown in Pl. XIII. fig. 2. In this section it is seen that the superior free surface of the colony is beset with claviform buccal cones (*Mk*); these, as already stated, are quite destitute of tentacles and have no septa; they are hollow, have a buccal aperture opening outwards (*M. o*), and another inner orifice (*M'. o'*) which leads into the interior of the body of the colony. The inner space is rather complex and contains various walls, the analogy of which with the ordinary septa of corals is very doubtful at the first glance. The body of *Polyparium* possesses a spacious cavity, which is divided into sections of equal size by the above-mentioned septa. These septa stand transversely to the long axis of the body and in a vertical longitudinal section are shown as bands (fig. 2). In this figure we see how the partition-walls (septa) are united in pairs. Each pair forms a special division which encloses an internal chamber (*bf*) and is separated from the neighbouring one by an intermediate chamber (*zf*). According to this description therefore the body of *Polyparium* presents a conglomeration of consecutive divisions or segments, which, however, cannot be characterized as metameres; for each metamere is a definite unit, which forms a particular part of the body, possesses only a single partition, and is immediately applied against its like. In *Polyparium* each segment is formed by two partitions, and is separated from the neighbouring segment by an intermediate chamber.

The partitions stand in a particular relation to the buccal cones on the one hand and to the acetabula of the sole on the other (fig. 2). Thus the interior chamber (*bf*) opens externally by means of the buccal aperture, but below, corresponding to the buccal apertures, are the acetabula, which are so distributed that each buccal cone possesses a corresponding acetabulum. Hence we may perhaps regard each buccal cone with its acetabulum as a simple individual, which, however, has not yet sufficiently individualized itself. I must, however, remark that each acetabulum possesses a separate claviform cavity; this stands in direct connexion with the lumen of the animal, and corresponds in position with the cavity of a buccal cone.

Before passing to the histology of *Polyparium* I may premise that in this respect the creature exactly agrees with the Actiniæ—not only the sequence of the layers, even the intimate structure of the tissues is in both cases exactly alike, and whoever has once seen a section from the wall of an Actinia will at once recognize the same thing in *Polyparium*. In accordance with the Actinian type the ectoderm, the ento-

derm, and a gelatinous intermediate layer are to be found here; but with them we have two different formations—one in the structure of the whole of the upper wall, the other in the acetabulum. We commence our descriptian with the upper wall, and have here to distinguish two different parts, namely the small buccal cones and the upper surface (between the buccal cones), which we will indicate as the buccal disk. These two parts only differ by the degree of development of their layers; thus in the buccal cones the muscular layer is quite inconsiderably developed, but between them it is very considerable. In order to understand the structure more clearly we will study a section of the upper wall. This section is taken parallel to the long axis and perpendicular to the septa.

The ectoderm (figs. 4, 5) is divisible into three separate layers; the outer one, which at the same time is the most considerable, is composed of very long, fine, perfectly filiform, epithelial elements; the nuclei in this are distributed in two aggregations, of which the upper one is situated close to the nematocysts and the lower one much deeper, occupying exactly the middle of the height (*em. z*). As the foundation of this outer layer there is a thin stratum of a finely fibrillar substance (*Nv*) in which a few nuclei are scattered. Lastly, quite at the bottom we find a layer of muscular fibres (*Qm*); in transverse section this appears as an aggregation of shining corpuscles. The three layers above mentioned are to be regarded, as in the Actiniæ, as epithelial, nervous and muscular layers.

The outer, epithelial layer contains quite different elements —there are here support-, sense-, urticating-, and finally gland-cells. From the extraordinary fineness of the elements and the involution of the filiform prolongations of their inner parts it is difficult to distinguish the support-cells from the sense-cells, and I have only succeeded in seeing clearly the sense-cells. These are elements drawn out into a thread-like form (*sz*), of which the nuclei are situated in the first third of the cell and in the section form the aggregation which is closely approximated to the lower extremities of the nematocysts. The protoplasm accumulates more strongly in the neighbourhood of the nucleus, and hence there is a thickening of the sense-cell which is produced inwards towards the periphery into a fine process; the process, however, appears not to be plasmatic, but fibrillar, and even homogeneous. From the single specimen of *Polyparium* at my disposal, and which was hardened in alcohol, I rarely succeeded in obtaining good teased-out preparations; nevertheless I was able to convince myself that here matters are exactly as in the

Actinia—that is to say, the sense-fibril (Pl. XIII. fig. 7, *sf*) passes directly or after one division into the nervous layer, with the fibrils of which it perfectly assimilates. I could not observe any sense-hairs upon the ectodermal elements.

As usual, however, other elements predominate in the ectoderm, namely the urticating-cells; but as these scarcely differ from the ordinary type, I have not much to say about their structure. I need only mention that each urticating-cell is surrounded by a thin layer of protoplasm, and that a strongly refractive nucleus is to be found at the bottom of each cell. A fibril is given off downwards from the nematocyst, which passes through the whole ectodermal layer, and is attached by a thickening or disk to a muscular fibril (fig. 7).

The above-mentioned superior aggregation of nuclei belongs to definite cells, whether sense-, gland-, or urticating-cells; but the lower one has a part in no specific cells, it belongs to particular elements which are wedged in between sense-, support-, or urticating-fibrils. These cells have no connexion with the fibrils adjacent to them, such as we have seen, for example, in the case of the sense-cells; here they are rather loosely contiguous, and penetrate the fibrillar layer with their processes. Nevertheless we can hardly assume that in them we have to deal with nerve-cells; they are rather simple embryonal cells, which serve to complete the epithelial layer (figs. 7 and 8, *em. z*).

I can scarcely say much about the nerve-layer, nor can I give by any means so detailed a view of it as has been furnished for the Actiniæ by the brothers Hertwig. My statements are limited to the demonstration that the structure is the same in both cases. The nerve-layer is shown with particular distinctness in sections, when it appears to be partly finely granular, partly fibrillar; but whether this layer is formed by the basal extremities of various epithelial cells or whether independent fibres take part in it is hardly to be decided. While on the one hand the nerve-layer is connected with the epithelial cells, on the other it gives off fine fibrils to the underlying muscular layer. With a view to parallelization with the Actiniæ I must state that the nerve-layer is distributed everywhere in *Polyparium*, and occurs both in the buccal cones and in the buccal disk, as is described in the case of *Cerianthus* among the Actiniæ.

The muscular layer follows immediately upon the nerve-layer and consists of long and very thin, smooth fibres, which appear quite homogeneous and bear no nuclei or cells; as usual, these fibres lie in special depressions of the supporting lamella, and are undivided and, as it were, adherent as usual

upon special lamellar processes of the latter. The direction of the muscular fibres of the ectoderm is parallel to the longitudinal axis, and in the buccal cones vertical. Where the latter pass into the buccal disk the fibres acquire the above-mentioned direction.

This description of the structure of a portion of the wall of *Polyparium* proves indisputably that in it we have to do with an Actinia; in both instances we find points of approximation common to them and the other Cœlenterata, or more properly the Hydroida and Siphonophora. So far as I know this attempt has not hitherto been made, and we are quite in the dark on the subject. In my former memoir upon the histology of the Siphonophora* I endeavoured to show that cnidoblasts, sense-cells, and nerve-cells are not only altered epithelial cells, but that, when we have to do with animals (such as the Siphonophora, for example) in which an epithelial muscular system occurs, these have a direct genetic relation to the muscular fibrils, and therefore are to be regarded as altered muscle-cells. According to this an embryonal cell, after it has separated off one or more muscular fibrils, acquires quite a different specific function, and becomes converted into weapon-, gland-, or sense-elements. If we adhere to this principle, it becomes a question in what manner the Actinia-structure is to be referred to this type. In the Siphonophora, especially in *Forskalia*, we see that a nerve-cell, or rather a nerve-muscle-cell, scarcely separates from the epithelia, and lies directly applied to the latter; in the Actiniæ this process has gone further—here the nerve-cells have fallen low down and formed a special layer; but this stands in immediate relation to the muscular fibrils which cling to them. To a certain extent a genetic relation between the muscle- and nerve-layers is to be seen in *Polyparium ambulans*, inasmuch as the muscle-layer possesses no cell-nuclei. The smooth non-varicose form of the muscular fibrils leads to the belief that the nuclei of the muscle-cells have not become assimilated to the muscular fibrils, but are to be sought elsewhere; hence I see no impossibility in the assumption that the cells of the nerve-layer are to be regarded, not as true nerve-cells, but as nerve-muscle-cells, or, otherwise, as metamorphosed muscle-cells.

Now if we bear in mind that in the Siphonophora the relation of the cnidoblasts to the muscular fibrils is very intimate, and that in it we find a whole series of progressive transformations, the extreme form of such transformation,

* Korotneff, "Histologie der Siphonophoren," in Mitth. Zool. Stat. Neapel, Band v.

which is to be observed in the Actiniæ, will be sufficiently clear to us. The first step is that in which the cnidoblast is closely applied to the fibril, forms its essential muscle-cell, and therefore, together with the fibril, cannot be characterized otherwise than as a true muscle-form. However, we shall find that the cnidoblast itself is by no means to be regarded as an integral part of the muscular fibre, because it remains at some distance from the fibril itself (tentacles of *Physophora*) and communicates with the fibril by means of fine filaments. If this notion needs any further confirmation we must pay special attention to the connexion between the cnidoblast and a muscular fibril in *Polyparium ambulans*; in my opinion it proves incontrovertibly that the cnidoblast in *Polyparium* is a true muscle-cell which, in the metamorphosis of the ectoderm, has entirely quitted its original situation and taken up a peripheral position (fig. 8). In this way we shall recognize that the same course of transformations of the muscle-cell exists for all the other elements of the Actinian body; nerve-cells, sense-cells, gland-cells, and cnidoblasts are therefore to be regarded as metamorphosed epithelial muscles, and hence we may assume that the first step in the metamorphosis of an embryonal cell is the separation of a muscular fibril; but herewith the cell does not appear to have exhausted its powers of furnishing something else, and thus are produced the histological double-structures already more than once described (by the brothers Hertwig in the Actiniæ and by myself in *Hydra* and the Siphonophora), such as epithelial muscle-cells, nerve-muscle-cells *, sense-muscle-cells, and gland-muscle-cells. As a matter of course this histological process appears to be the longer one, and may be often greatly abridged, and an embryonal cell, without satisfying the first requirement of the organism, the need of locomotion, directly acquires various specific properties, and becomes converted directly into a nerve-, sense-, or gland-cell, overleaping the intermediate stage of the myoblast.

The supporting lamella is an elastic membranule (figs. 4, 5, *st. l*), which is considerably thicker in the lateral margin than in the upper surface of *Polyparium* and much thicker than in the buccal cones. Throughout it consists of fine felt-like fibres which are imbedded in a homogeneous intermediate substance. Between the fibres there are numerous small

* Especially since the discovery of special nerve-cells in the Hydroida I cannot recognize the epithelial-muscle cells in *Hydra* as true neuro-muscle cells in Kleinenberg's sense. Nevertheless the ingenious neuro-muscle theory remains still valid.

fusiform cells, which pass off into processes; the protoplasm of the cells is rather coarsely granular.

The entoderm of *Polyparium* was unfortunately insufficiently investigated by me, and therefore I can hardly touch upon such delicate questions as, for example, the nerve-cells or nerve-fibrils. Almost throughout (figs. 4 and 9) the entoderm is one-layered, and consists of elongated cells which show remains of flagella upon their surface. At the bottom of the entodermal cells there are fine muscular fibrils, all of which have a definite longitudinal direction, therefore parallel to the long axis of the colony; these muscles never form groups, but are distributed in a delicate layer. The relation of the cell-bodies to the fibrils proves that we have to do with entodermal muscle-cells. Between these cells simple glands also occur (fig. 9, *Dr*). I may also mention that the whole entoderm is filled with round, yellow, parasitic cells (*pz*); these usually accumulate in such quantities that the cell-nuclei are entirely concealed by them. These parasitic cells do not seem to occur in the gland-cells.

With regard to the lower surface of the foot of *Polyparium*, it has already been mentioned that this is covered with small acetabula (fig. 2) and that these acetabula are arranged in rows and very accurately correspond with the buccal cones of the upper surface. The structure of the whole ectodermal layer, whether between or upon the acetabula, is quite uniform throughout, differing only in thickness; the thickest parts are the margins of the acetabula, and then the middle, which is separated from the margins by a groove. The histological constitution of this ectoderm is quite different from that of the lateral margin or the upper surface of *Polyparium*. When taken from the middle of an acetabulum a section presents the following peculiarities (fig. 6):—Three layers are to be distinguished in it; superficially there is a finely granular glandular layer, in the middle a dense nuclear layer, and at the bottom, lying directly upon the supporting lamella, a considerable, finely fibrillar, fibrous layer. As in the ectoderm of the wall-lamina, the whole ectoderm of the foot, from the surface to the bottom, is traversed by the same elements. Almost the whole mass consists of elongated gland-cells, at the bottom of which (fig. 8, *Dr*) there is a cell-nucleus, which marks off a fibrillar part extending to the supporting lamella. These glands no doubt secrete the mucous substance which accumulates in clots on the free upper surface.

Among the glands many sense-cells occur, exactly like those of the wall-lamina (fig. 6, *sz*). It seems to be a remarkable fact that the sense-cells terminate directly upon

the supporting lamella, and therefore can conduct no further unless we assume that the impressions received may be transferred to the supporting lamella itself, which is perhaps capable of contraction, or perhaps rather to its cells. The sense-cells occur most numerously upon the acetabula, and are particularly observable in their inner inflation. This arrangement seems to indicate that, in creeping, *Polyparium* feels the surface of the supporting object so as to seek out a definite course.

The nuclei which occur in such quantities among the ectodermal cells belong chiefly not to the fibrillar elements, but to small embryonal cells (*em. z*), which are very numerous, and in this case, where there is no special nerve-layer, may also perform the function of nerve-cells. Besides the gland- and sense-cells the so-called support-cells may also possibly occur; but I could not distinguish them from the other elements.

From this description the acetabula of *Polyparium* are certainly of primitive structure, inasmuch as they possess no true musculature; but they must be regarded as the first stage of an adhesive apparatus, and not merely as inflated portions of the wall. Although the acetabula of the foot have no immediate relation to muscles, this by no means excludes the possibility of an indirect relation; as we shall soon see, there are, in the interior of the body, special muscles which serve only to pull away the acetabula from the surface of adhesion. The supporting lamella of the foot is remarkable for its considerable development.

The entoderm possesses special villiform outgrowths which project into the interior of the body. The interior, or, in other words, the lumen, is here, as already stated, clavate in form and occupies the whole acetabulum, and may receive the name of the stomach (Pl. XIII. fig. 2, *Mg.*); the occurrence of entodermal villi shows that assimilation takes place here more actively than elsewhere.

We pass now to the examination of the intimate structure of the septa, and have in this to investigate the distribution of the muscular fibres. As the framework of each septum we have in *Polyparium* the supporting lamella, which is clothed with muscles in various stages of development. The surfaces of each septum are unequally furnished with muscles, according as the particular surface is turned towards an intermediate or an interior chamber. The intermediate-chamber-surface is clothed with vertical fibres, the interior-chamber-surface on the contrary with transverse fibres. The vertical muscles are the weakest; upon a flattened septum they form an unin-

terrupted layer of fibres, which commence at the buccal disk, where the septa are inserted, and extend thence downwards, to lose themselves in the foot-disk. The transverse muscles, on the contrary, are the strongest, and form strong bundles of fibres, which run from one side of the body of the *Polyparium* to the other. Fig. 2 shows how strongly the transverse muscles are developed; immediately behind the buccal aperture they form a large cushion (*t. F*), which projects far into the interior chamber, nearly meeting with the cushion of the opposite side. The cushion, however, stops in the middle of the septum, being sharply separated by a constriction from the septum, which now becomes thinner. The inferior half of each septum is clothed with a single layer of transverse fibres, and this lines the inner surface of the so-called stomachal cavity, which, as already stated, penetrates into the interior of each acetabulum. The whole surface of the muscles is covered with a single-layered entoderm (fig. 9), which, at the bottom, contains the strongly developed muscular fibres imbedded in a common plasma.

On examining into the peculiarities of this structure it appears that its greatest divergence from the polyp-type consists in the entire absence of strongly developed bands of muscular bundles in *Polyparium*. But if we consider that the muscles on the one hand are in relation to the tentacles, and on the other serve for the retraction of the whole buccal disk into the interior of the body of the Actinia, it becomes at once quite intelligible to us that such bands are wanting in *Polyparium* as being superfluous, for no tentacles are present, and from the great number of small buccal orifices the buccal disk cannot be retracted. Nevertheless there is a point of argument which may enable us to establish an analogy; thus the vertical muscles, arranged in a thin fibrous layer, which line the intermediate chambers are homologous with the true muscular bands. Thus in *Polyparium* we find a reversed picture with relation to the polyps; the vertical fibres, which are the strongest in the polyps, are the least strongly developed in *Polyparium*, and *vice versâ* the transverse fibres are the strongest in *Polyparium*, and may therefore be characterized as "transverse bands (*transversale Fahnen*)."

In order to find something similar among the polyps we must go back to the statements of Hollard *. That naturalist first of all described a parieto-basilar muscle in the Actiniæ; this muscle consists of fibres which run from the wall-lamina to the pedal disk to draw in the latter; it appears

* "Monographie anatomique du genre Actinia de Linné," &c., in Ann. Sci. Nat. Zool. sér. 3, tome xv. p. 257.

as a thick cushion which runs transversely above the layer of transverse muscles. The brothers Hertwig regard this cushion as a fold-formation of the base of the septa caused by the increased mass of the muscles here situated. The parieto-basilar muscle is most strongly developed in *Tealia crassicornis*, and in this form, according to the figures illustrating Hertwig's investigation *, we have a good right to assume that the muscular fibres of the base of one septum pass into the opposite septum. At any rate, we may assume that at the meeting of the opposite septa the muscular cushions pass into each other and give origin to a structure analogous to the "transverse bands."

It still remains for me to decide an important point which relates to the relations of the septa and likewise of the muscles to one another. We have already seen that in *Polyparium* the inner chambers and intermediate chambers follow each other alternately; the inner chamber represents the gastral space and the intermediate chamber the place where new septa are formed. This alternating position is not without relation to the muscular system. Hollard has already expressed the opinion that the longitudinal muscles which, in transverse sections, are immediately recognized as thick pads, are turned towards one another and enclosed in the central chamber, while the transverse muscles, on the contrary, belong only to the intermediate chamber. If we consider *Polyparium* from this point of view we find the direct contrary; in this form the longitudinal muscles (vertical muscles) belong to the intermediate chamber, while the transverse muscles ("transverse bands") only occur in the internal chamber. In order to explain this phenomenon we are compelled to submit the principle established by Hollard to a rigid analysis.

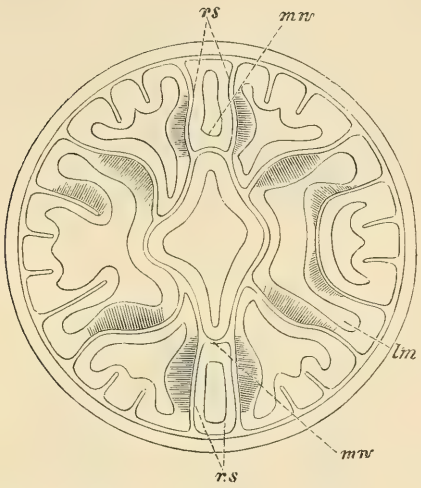
Rötteken and Schneider † have already indicated that two pairs of septa in the body of the Actinia have really an exceptional position—these are the so-called directional septa which have a special significance for the orientation. These septa are situated opposite each other, and have a particular relation to the position of the buccal aperture and the œsophageal tube: thus the buccal aperture possesses two angles from which two deep grooves run down upon the inside of the œsophageal tube; the insertion of the directional septa corresponds with the buccal angles and the grooves of the

* O. and R. Hertwig, 'Die Actinien, anat. und histol. Untersucht' (Jena, 1879).

† Schneider and Rötteken, "Ueber den Bau der Actinien und Korallen," in Sitzungsb. der Oberhess. Gesellsch., March 1871.

œsophagus (fig. I.). The relation of the musculature on the directional septa is different from that on other septa—the transverse muscles are directed towards them, the longitudinal from them. Thus, with the directional septa it is exactly as

Fig. I.



Transverse section through a young *Adamsia diaphana*: *mw*, mouth-angles; *rs*, directional septa; *lm*, longitudinal muscles. (After Hertwig.)

in the interior chambers of *Polyparium*, which is certainly not without significance and needs homologizing. Unfortunately embryology gives us no data for this purpose, because the researches of Kowalevsky † and Lacaze-Duthiers ‡ upon this subject do not thoroughly exhaust the question and are in contradiction to each other. We must therefore treat this question quite *à priori*. Very probably the directional septa of the Actiniæ are the first formed; they will probably be *archisepta*; and this postulate is to a certain extent confirmed by the fact that the directional septa undoubtedly correspond to the four longitudinal muscles of the *Scyphistoma*. In the

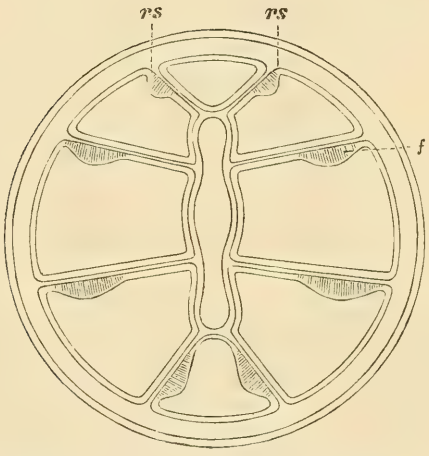
† A. Kowalevsky, "Unterschungen über die Entwicklung der Cœlenteraten," in Nachr. k. Ges. der Freunde der Natur, Anthr. und Ethnogr. Moscow, 1873 (in Russian).

‡ Lacaze-Duthiers, "Développement des Coralliaries," in Arch. Zool. expér. et gén. tome i. 1872.

Scyphistoma, which, for various reasons, we must regard as a most simple and primitive Actinia, the above-mentioned longitudinal muscles are placed, as has been described in the case of the directional septa, in close relation to the buccal aperture. Hence the arrangement of the muscles on the directional septa, in which the archetypal form is to be seen, is indicative of various homologies. In this way, then, the relation of the muscles to the septa in *Polyparium* is not abnormal, but, on the contrary, quite typical.

I may further mention that if the principle established by Hollard is applicable in general and not in details to the Actiniæ, it nevertheless loses its significance outside this group. Thus in a transverse section of an *Alcyonium* we see, as the brothers Hertwig have shown (see fig. II.), that in the circumference of the section there is a point, looking from

Fig. II.



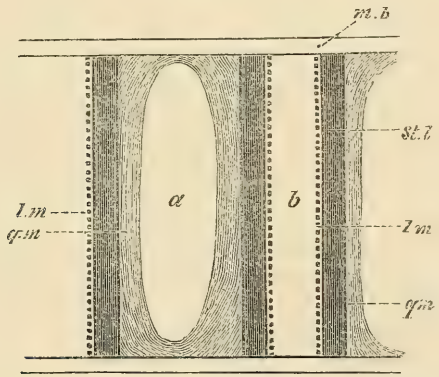
Transverse section through a polyp of *Alcyonium*: *rs*, directional septa; *f*, muscular bands. (From the work of the brothers Hertwig.)

which all the septa have the muscles turned away, four on the right and four on the left-hand side, and a second opposite point, looking from which the muscles are turned towards it; in other words, we find the longitudinal muscles turned towards one another, in accordance with Hollard's principle, only on one pair of the directional septa, all the others being

turned away. In this respect, therefore, *Polyparium* makes no special exception.

Notwithstanding all this, it is necessary to show why the change which we find in the strength of the muscles in *Polyparium* has been brought about. This question may be decided upon a mechanical principle. We have seen that the transverse bands (*q.m*) project strongly into the interior of the gastral cavity, pass over with their fibres to the side-wall (*m.b*), and in this way form an arch, the points of fixation of which are to be sought laterally upon the side-wall. During movement, in the creeping of *Polyparium*, the transverse fibres are the most active, and when they contract they must, as in the bent bow, widen the lumen of the interior chamber (fig. III.). If we could imagine that the above-mentioned transverse bands projected, not into the interior chamber

Fig. III.



a, interior chamber; *b*, intermediate chamber; *m.b*, side-wall; *st. l*, supporting lamella; *q.m*, transverse muscular bands; *l.m*, longitudinal muscles.

but into the intermediate chamber, then the interior chamber (*a*) would be closed by their contraction. But we must consider that the nutrition of the animal must depend unconditionally upon its movement; the animal, or the colony, only creeps in order to obtain nourishment, and therefore during locomotion the buccal aperture must remain wide open, in order that the food met with may pass directly into the stomach. Thus it becomes clear that the occurrence of the transverse bands in the interior chamber and of the vertical musculature in the intermediate chamber is not only

naturally typical, but also is fully in accordance with the requirements of the case.

Lastly, that the septa of *Polyparium* are homologous with those of the Actiniæ may be proved by the production of the new septa. These occur in various stages of development in the intermediate chambers; they always originate in pairs, and each pair consists of two septa of equal size; when these are quite small they appear to consist only of a supporting lamella, which is covered on each side with a muscular layer, and it is only after the septa have grown up so as to exceed half the vertical diameter of the colony that the free margin (Pl. XIII. fig. 2, *s'*) begins to thicken, forming a pad, and this is the commencement of the formation of a transverse band. Step for step with the growth of the septa proceeds the development of the muscular pad, and after the septa have reached the buccal surface their amalgamation with the latter ensues, together with the production of a buccal cone, which finally acquires a mouth-opening. The development of the acetabulum likewise goes on at the same time. When the septa are still quite small we already observe an annular, scarcely perceptible fold, which rises more and more and distinctly acquires the form of a knob. Thus it is clear that the growth of *Polyparium* in length takes place by an interpolation of new members which bear buccal apertures above and acetabula below.

I must further mention that special orifices occur in the septa, enabling a communication to take place between the interseptal spaces; these are the so-called internal septal stomata described in the Actiniæ. These stomata are oval and have thickened margins closing the aperture, which would indicate the presence of a circular musculature (fig. 3).

No mesenterial filaments or sexual organs occurred on the septa of *Polyparium*; the former are entirely deficient, the latter probably are not developed at the time when I found the animal, that is in the month of September. There can, however, hardly be any doubt that we have to do with a sexually mature organism. In this respect the animal agrees exactly with the Actiniæ, in which sexual maturity also occurs only at definite periods.

In the body of *Polyparium* we have therefore two systems of muscles, external and internal. The first form two different groups:—1, transverse muscles, which belong to the ectoderm, and pass directly from the buccal cones into the buccal disk; 2, longitudinal muscles, which belong to the entoderm, and run along the whole of the body. The internal muscles may also be divided into two separate groups, both of which

occur in the septa; these are, 1, transverse bands, and 2, vertical muscles. All these systems of muscles serve the same purpose; they provide for the locomotion of the animal. The most important in this respect are the transverse bands; they shorten the transverse diameter of the polypary by bringing the lateral parts of the body nearer together; with the shortening of the transverse bands the body is extended, which is accompanied to a certain extent by an elongation of the longitudinal muscles. The weaker vertical muscles of the septa play a subordinate part, performing a much less onerous work; they serve to pull up the acetabula from the supporting body, which is the first act in the locomotion of *Polyparium*. On further investigation of the processes of locomotion in this creature we find that the liberation and lifting of the acetabula certainly do not occur simultaneously throughout the whole length of the animal, but only at a particular part of the colony—whether it is one transverse row of acetabula, and therefore an intermediate chamber with a transverse chamber, or a greater number of such segments that is included, I cannot say with certainty, although I am inclined to think that only one segment is moved at once. After the abbreviation of the transverse bands and the elongation of the longitudinal muscles the acetabula separated from the surface of support are pushed further, and this no doubt goes on successively throughout the whole length of the animal. This mode of locomotion cannot be called *gliding* such as we observe in many Actiniæ, but a true *walking*, as the acetabula are to be regarded as feet, and in motion cause an undulatory advance; but as the acetabula are distributed along the whole disk of the foot, and occur in considerable numbers, the progression may be discriminated into separate actions.

It is not easy to determine the true taxonomic position of *Polyparium ambulans*. The first impression that this form produces is something quite peculiar, something that hardly reminds us of any other form of Cœlenterate. In summarizing the different characteristics of *Polyparium* we shall specially note the four following points:—1, absence of tentacles; 2, occurrence of various buccal cones which lead into a common cavity without, however, possessing an œsophagus; 3, apparent absence of radial septa; and 4, occurrence of the very peculiar partitions which divide the body of *Polyparium* into segments.

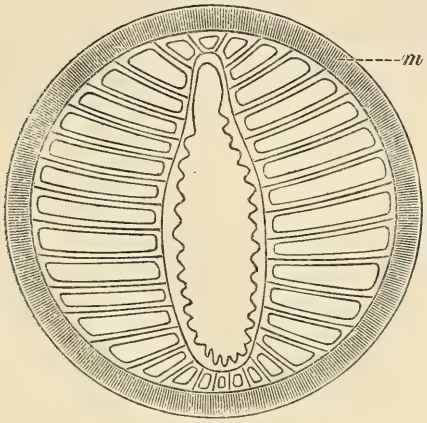
To show the affinity of our form with other polyps, we must refer all these peculiarities of structure to the common characters of the polyp-type, and at the same time regard them as definite results of a change brought about by special needs.

We commence with the tentacles:—Where ought these to occur? Certainly either at each buccal aperture or at the margin of the whole colony. A *Mœandrina* enables us to decide this question. In this form we see individual polyps, or more properly buccal cones, like those of *Polyparium*, distributed in bands on the surface of a globular polypary, the buccal cones being arranged in a series exactly in the middle of each band. In this way each band resembles a *Polyparium*, but with the difference that the buccal cones occur in greater number in the latter. But the most important thing is in the distribution of the tentacles in *Mœandrina*; these do not surround each mouth-aperture, but stand along the margin of each band. If we conceive that in a common Actinia a multiplicity of mouth-openings has been produced by their division, we shall get a band-like, *Mœandrina*-like form in which also the tentacles originate at the margin. In *Polyparium* therefore we ought to seek for tentacles at the margin, and regard them as having disappeared, such a disappearance being explicable to a certain extent by change in the mode of life. As a *Mœandrina* is an adherent organism it is, as regards nourishment, under much less favourable conditions than *Polyparium ambulans*, which can change its place with comparative rapidity; hence the tentacles are much more necessary to *Mœandrina* than to *Polyparium*, although they are rather rudimentary.

As regards the buccal apertures, there can hardly be any doubt that their number does not denote an individualization, but rather a division, and the absence of an œsophagus at each aperture somewhat strengthens this supposition. Such a complete reduction of the tentacles and considerable increase of the mouth-apertures not only has an influence upon the external habit of the animal but also affects its internal organization. In the first place we must here mention the septa; under such circumstances they must certainly be subject to a fundamental alteration. That the septa of *Polyparium* must be homologous with the septa of a simple Actinia we have already seen to be probable, nevertheless their divergent form remains as a considerable obstacle. If we imagine the œsophagus of a polyp to have disappeared, the affair of the septa will certainly stand on quite a different footing, they must be free in the interior of the gastral

cavity; further, we may assume the radial arrangement of the septa to have disappeared, on the one hand, in consequence

Fig. IV.



Cross section of *Cerianthus*: *m*, muscles of the wall-lamina.

of the division of the primary mouth-opening into a number of secondary ones, and, on the other, on account of the extraordinary elongation of the colony, and therefore what exists in *Polyparium* is to be regarded as regular. The free existence also has not been without influence; for the performance of the task of carrying out definite movements the parieto-basilar muscle is converted into the transverse muscles (transverse bands), and in this process corresponding septa of opposite sides must have met and become converted into partition-like structures. In this way the radiate type of a polyp may easily be converted into a bilateral type. In order to make this metamorphosis intelligible the best way is to have before us a transverse section of a *Cerianthus* (fig. IV.). If we imagine the buccal aperture in this divided, the opposite septa, which approach so nearly as to touch at the bottom of the inner gastral cavity, will necessarily grow together*.

* The comparison of *Cerianthus* with *Polyparium* is, however, the more admissible, because, as has been shown, these forms are very similar histologically—for example, in this respect, that the wall in both cases possesses a muscular and nervous layer.

EXPLANATION OF PLATE XIII.

bf, internal chamber.
Dr, glands.
e. m, entodermal muscles.
em. z, embryonal cells.
Lm, longitudinal muscles.
Mg, stomach.
Mk, buccal cone.
M.o, mouth-opening.
M' o', inner mouth-opening.
Mw, gastral pads.
N, nematocysts.
Nv, nervous layer.
pz, parasitic cells.
Qm, transverse muscles.
s, developed septa.
s', young septa.
sf, fibrils of the sense-cells.
st. l, supporting lamella.
st. z, supporting cells.
st'. z', cells of the supporting lamella.
sz, sense-cells.
t. F, transverse bands.
z. f, intermediate chamber.

Fig. 1. *Polyparium ambulans* enlarged $2\frac{1}{2}$ times; the upper surface covered with buccal cones, the lower with acetabula:
Fig. 2. A longitudinal section of *Polyparium*, showing buccal cones above and acetabula below; small and large septa. Transverse bands (*t. F*) strongly developed.
Fig. 3. A septal stoma.
Fig. 4. Section of the wall of a buccal cone, in which all the layers characteristic of an Actinia (muscles, nerves, fibrillar nematocyst layer, &c.) occur.
Fig. 5. Section of the buccal disk which stretches between the buccal cones. The layers follow the same order as in the last figure.
Fig. 6. Section of the pedal disk near an acetabulum.
Fig. 7. Teased-out preparation from the buccal disk, in which are to be distinguished nematocysts, sense-cells, nerve- and muscular layers. To be noted the relations which exist between the muscles (*m*) and the fibrillæ emanating from the nematocysts.
Fig. 8. Teased-out preparation from the pedal disk, in which gland- and sense-cells are to be distinguished.
Fig. 9. Entoderm filled with parasitic cells.

XXII.—*Description of a new Genus and Species of* Polyzonidæ. By R. Innes Pocock.

[Plate XIV.]

Pseudodesmus, genus novum.

Platydesmo (Lucas) propinquum. Corpore longo, supra tuberculorum, infra carinarum serie quoque latere prædito. Segmentorum numero majore quam septuaginta; segmento ultimo postice haud acuto; segmentis, primo et ultimo exceptis, carinas prope ad libellam emergentes parte lateris inferiore gerentibus et dorsum medium canaliculatis. Carina quaque, tribus anticis exceptis, in margine laterali foramen repugnatorium

gerente. Segmentis quatuor anticis binis pedibus, cæteris binis pedum paribus instructis; ultimo (et penultimo?) pedibus carente. Pedibus articulis sex constantibus; ultimo pedis articulo apicem ungue armato. Laminis pedigeris liberis. Capite sub segmentis anticis flexo, fronte convexa; margine antico vix in rostrum producto. Oculis nullis. Antennis articulis septem constantibus; in capitis lateribus positis; articulo extremo minimo. Mandibulis occultis. Gnathochilario manifesto; stipitibus magnis; malis et cardinibus haud conspicuis; lobis linguæ parvæ et tenuis nullis; mento malleo simili et magno.

Owing to scarcity of material I have been unable satisfactorily to determine whether the mandibles be in reality absent or not. The fact of their occurrence in *Siphonophora* and *Platydesmus* leads me to believe that owing to my imperfect examination of the mouth-parts their presence has been overlooked in this specimen.

This genus differs from *Platydesmus* principally in the absence of eyes and in the possession of a greater number of segments. With *Dolistenus* (Fanz.) I am unable to compare it, owing to my ignorance of the structure of the mouth-parts in this form (*cf. infrà*, Note).

Pseudodesmus verrucosus, n. sp.

Number of segments in one specimen seventy-six, in another seventy-two. Length of longer individual 34 millim., width 4½ millim.

Head somewhat pointed in front, rounded behind, convex from before backwards, and from side to side; thickly and finely punctured, and thickly clothed with short hairs. All the segments, the limbs, and antennæ punctured and more or less thickly covered with hairs; the free ends of the keels, the large tubercles, and the anal valves not punctured and not hairy. The first segment bearing an irregular row of tubercles on its anterior half, and provided on each side with a larger lateral tubercle, corresponding in position with the keels of the succeeding segments. That portion of each segment which lies between the keel below and the large dorsal tubercle above bearing one or more smaller tubercles, which are more numerous upon the first three segments than upon the others. Posterior border of last segment rounded and tubercular. Anal valves convex and smooth; posterior border of subanal plate straight; keels of the last segment but one projecting directly backwards. In one specimen the last, and in the other the last two segments are without limbs.

Colour mostly testaceous or yellowish brown; legs and

keels testaceous, lateral portions of the segments darker but mottled, the darker shades occurring in patches. Most of the large dorsal tubercles almost black, some bright yellow, a few dull-coloured; the yellow tubercles in patches of two, three, or four together, but not occurring at definite intervals.

Two female specimens from Perak in the Malay Peninsula.

In 1872 M. de Saussure, basing his classification upon the form of the head and jaws, divided the family Polyzonidæ into two tribes—the Platydesmia, to contain *Platydesmus*, and the Polyzonia, to contain *Polyzonium* and *Siphonophora*; and Dr. Latzel in 1884 also divided the Polyzonidæ into two subfamilies, for one of which he adopted the term Platydesmia, while to the other he gave the name Dolistenia. But the latter author, considering the number of body-segments to be a character of systematic value, included in the Platydesmia all those suctorial Myriopods which possess fewer than seventy segments, while the Dolistenia contained all those forms in which the body is composed of more than seventy segments. This arrangement brought about the association of *Polyzonium* with *Platydesmus* and the separation of *Polyzonium* from *Siphonophora*, and if adopted in the present case would lead me to assign to *Pseudodesmus* a place, not with *Platydesmus*, but with *Siphonophora*, thus showing that, in my opinion, the relationship between *Siphonophora* and *Pseudodesmus* is greater than the relationship between the latter and *Platydesmus*. But that is not the case; the form of the gnathochilarium shows that *Platydesmus* and *Pseudodesmus* are closely allied, and the form of the proboscis shows that *Polyzonium* and *Siphonophora* are closely allied. These two things, and the knowledge of the fact that the number of segments, being very variable, is a character practically valueless for classification, have led me to reject the divisions of Dr. Latzel and to adopt, at all events provisionally, the older ones of M. de Saussure; but at the same time it seems to be very probable that careful examination of the mouth-parts of genera that have hitherto been but poorly described will, by bringing to light intermediate forms, render impossible the attempt to divide the Polyzonidæ into groups larger than genera.

Owing to the scanty descriptions which at present exist of the following forms—*Octoglena* (Wood), *Petaserpes* (Cope), *Androgna thus* (Cope), and *Dolistenus* (Fanzago)—it is impossible to associate them with either of the subfamilies adopted; and it must be confessed that the classification of Dr. Latzel highly commends itself from the fact that in formulating it the author was able, inasmuch as the number of segments

and very little else was known in each case, to assign to the North-American genera a position in the Platydesmia and to associate *Dolistenus* with *Siphonophora* in the subfamily Dolistenia. Whether *Octoglena*, *Petaserpes*, and *Andrognathus* be really related to *Platydesmus* and to *Pseudodesmus* remains to be shown.

Family **Polyzonidæ**.

Subfam. 1. *Platydesmini*.

Maxillis secundi paris *Juli* gnathochilario similibus.

1. Platydesmus.

Capite oculis ornato; numero segmentorum minore quam septuaginta.

2. Pseudodesmus.

Oculis nullis; numero segmentorum majore quam septuaginta.

Subfam. 2. *Polyzonini*.

Gnathochilario in laminam antice acutam, simplicem, *Juli* gnathochilario haud similem mutato.

1. Polyzonium.

Capite oculis ornato; numero segmentorum minore quam septuaginta.

2. Siphonophora.

Oculis nullis; numero segmentorum majore quam septuaginta.

Note.—Since sending the above to press I have come across, in the work of Antonio Berlese upon the Acari, Myriopoda, and Pseudoscorpiones of Italy, a figure of the gnathochilarium of *Dolistenus*, which shows that, as regards the mouth-parts, this genus is more nearly allied to *Pseudodesmus* than to *Siphonophora*, and will therefore be classed in the subfamily Platydesmini.

The form of the mentum, the shape of the body-rings, and the possession of more than one hundred segments are characters sufficient to separate *Dolistenus* from *Pseudodesmus*.

EXPLANATION OF PLATE XIV.

Fig. 1. Lower view of the anterior portion of the body of *P. verrucosus*.
Fig. 2. Anterior view of a single segment of *P. verrucosus*.
Fig. 3. Lower view of the posterior portion of the body of *P. verrucosus*.
Fig. 4. Upper view of anterior segments.
Fig. 5. Upper view of middle segments.
Fig. 6. Upper view of posterior segments.
Fig. 7. Antenna.
Fig. 8. Leg.
Fig. 9. First pair of feet.
Fig. 10. The gnathochilarium.
Fig. 11. The gnathochilarium of *Platydesmus*, after Saussure.
Fig. 12. The gnathochilarium of *Dolistenus*, after Berlese.

XXIII.—*Descriptions of new Species of* Cicadidæ.

By W. L. Distant.

Being engaged in the preparation of an illustrated monograph of the Oriental Cicadidæ, including those of China and Japan, to be published by the authorities of the Calcutta Museum, I am anxious to obtain all the material possible to make the work moderately complete. I therefore venture to make an appeal to entomologists who may possess specimens from those regions to favour me with an opportunity of examining the same.

The following species will be all subsequently either fully or structurally figured.

Pœcilopsaltria Hampsoni, n. sp.

♀. Head luteous; front with a number of black linear markings; vertex with a transverse, narrow, black fascia between the eyes and with a central black spot containing the ocelli. Pronotum greenish ochraceous, the disk with the following black markings:—a central I-shaped spot, on each side of which are some oblique linear markings; the lateral dilated margins are black and the anterior margin is narrowly and the posterior margin broadly dull reddish ochraceous. Mesonotum greenish ochraceous, with the following black spots:—four obconical from anterior margin, of which the central two are smallest; a large, oblong, discal spot, with a small, partly rounded spot on each side of it; the basal cruciform elevation dull reddish ochraceous. Abdomen above black. Body beneath with the face black, marked with luteous transverse lines; sternum somewhat ochraceously

pilose; abdomen beneath black, the segmental margins ochraceous, the anal appendage of the same colour; legs castaneous, streaked or spotted with piceous and luteous. Rostrum black, the basal portion luteous. Tegmina pale hyaline, with the venation brown, the costal membrane greenish, the basal third somewhat opaque, with darker transverse markings and small basal black markings; a double irregular series of dark brown spots cross the tegmina at about centre, a dark brown fascia at bases of upper apical areas, a few small subapical spots, and some small marginal spots of the same colour. Wings brownish ochraceous, paler at apex than at base and very pale across centre, with a white marginal spot near anal angle; the venation brown.

The rostrum reaches the basal abdominal segment; the lateral margins of the pronotum are distinctly angulated; the face is robustly gibbous, with a profound central longitudinal sulcation; the posterior tibiæ have three distinct spines on each side of apical half.

♀. Long. excl. tegm. 23 millim.; exp. tegm. 70 millim.

Hab. Nilgiri Hills, northern slopes, 5000 feet (May).

I am indebted for a knowledge of this fine species to G. F. Hampson, Esq., who captured it in the month of May of this year.

Pœcilopsaltria semusta, n. sp.

♂. Body dull ochraceous; head with the front and a broad fascia between the eyes black, the last containing the ocelli and two small ochraceous spots; pronotum with two central, discal, somewhat triangular, black spots, the lowermost largest and broadest, on each side of which are three narrow, oblique, black fasciæ, the lateral ampliated margins somewhat darker outwardly. Mesonotum with a large, black, central spot on anterior margin connected with the black margin of the basal cruciform elevation; on each side of this central spot is a large, black, obconical spot, which nearly crosses the disk; abdomen above dull castaneous, the segmental margins ochraceous. Head beneath with a broad black fascia between the eyes; face ochraceous, the upper portion black, enclosing an ochraceous spot, the central sulcation and transverse striations bright castaneous; body beneath ochraceous, with darker shadings; legs more or less tinged with castaneous; abdomen beneath as above; opercula brownish ochraceous, with the margins paler; rostrum ochraceous, with the apex pitchy. Tegmina brownish, with the following creamy markings:—a short, macular, transverse fascia near base; a broad, irregular, transverse, macular

fascia near centre; between this fascia and apex are two spots near costa, each divided by a vein, and an outer irregular series of submarginal spots; at the bases of apical areas the transverse veins are shaded with dark castaneous. Wings brownish, some basal streaks and central macular markings ochraceous; marginal fringe very pale ochraceous.

♂. Long. excl. tegm. 18 millim.; exp. tegm. 55 millim.

Hab. Chusan (Calc. Mus.).

The rostrum about reaches the apex of the first abdominal segment; the opercula are angularly rounded, do not overlap, are separated from each other, and just reach the base of the first abdominal segment; the face has a central, deep and broad, longitudinal sulcation extending through its lower two thirds, and it is also transversely striated to that extent.

Leptopsaltria nilgirensis, n. sp.

♀. Body above olivaceous green. Head with the front broadly margined with black, the vertex with a streak behind the eyes, some irregular markings in front, and the area of the ocelli black. Pronotum with the following black markings:—two central fasciæ, rounded and joined posteriorly, and laterally curved and produced on each side anteriorly; on each side of these fasciæ are three discal irregular spots and a large semicircular spot near each lateral margin. Mesonotum with the following black markings:—a central longitudinal line with a shorter curved and outwardly convex line on each side, followed by a small spot on anterior margin and by a sublateral curved and broken fascia, and a spot in front of each anterior angle of the cruciform elevation. Abdomen above with the segmental margins narrowly black and two black spots at base, and a smaller spot at apex of anal appendage. Body beneath pale olivaceous green; anterior margin and two central fasciæ (joined posteriorly) to face, some irregular spots on cheeks, segmental margins, the claspers and apex of anal appendage black. Legs olivaceous green; apices of the femora, tibiæ, and tarsi more or less pitchy. Rostrum olivaceous, with the apex black. Tegmina pale hyaline, with violaceous reflexions, the venation alternately black and ochraceous, a few obscure black markings at base; the costal membrane ochraceous; an ochraceous spot at base of upper ulnar area and the transverse veins at bases of the three upper apical areas broadly infuscated. Wings with the venation similar to tegmina, but spotless.

♀. Long. excl. tegm. 16 millim.; exp. tegm. 57 millim.

Hab. Nilgiris, northern slopes, 5000 feet, June (*G. F. Hampson, Esq.*)

The lateral margins of the pronotum are biangulated, the face is large and tumid, the rostrum reaches the third abdominal segment, and the body is more or less greyish and pilose.

This species much resembles the *Dundubia*? *clio*, Walk.; but it can be separated at once from that species by the very much shorter upper apical area to the tegmina &c.

Leptopsaltria lactea, n. sp.

♂. Head and pronotum ochraceous; head with the front, the area of the ocelli, and a transverse streak in front of eyes reddish ochraceous. Pronotum with the whole disk reddish ochraceous, with an indistinct, central, longitudinal fascia, on each side of which are two oblique excavated lines; the margins pale ochraceous. Mesonotum obscure ochraceous, with two obscure and mostly castaneous, central, obconical spots, on each side of which is a curved broken fascia of the same colour, and a large spot in front of the cruciform basal elevation. Abdomen above ochraceous, with a broad, central, castaneous fascia, which is notched and channelled outwardly; stigmata also castaneous. Body beneath and legs ochraceous; apices of the femora, bases and apices of the tibiæ, the tarsi, a spot on apical segment of abdomen, and apex of the rostrum castaneous. Tegmina and wings pale hyaline, with a strong milky-white suffusion or reflexion. Tegmina with the veins alternately ochraceous and castaneous; the costal membrane and a small costal spot at base of upper ulnar area ochraceous; transverse veins at bases of apical areas more or less infuscated, and a marginal row of pale fuscous spots placed on the apices of the veins. Wings with the venation dark castaneous and unspotted.

♂. Long. excl. tegm. 30 millim.; exp. tegm. 80 millim.

Hab. Sumatra (*Forbes*), February.

The body is long and gradually tapering towards apex; the lateral margins of the pronotum are concavely sinuate, not angulated. The face is broad and tumid, the central sulcation small and only distinct on apical half; the transverse ridges prominent. The rostrum extends a little beyond posterior coxæ. The opercula are small, only reaching the basal segment of the abdomen; they are outwardly oblique, broadly convex at apices, and again obliquely directed inwardly and upwardly.

Cosmopsaltria padda, n. sp.

♂. Head olivaceous; front with the margins and a central

fascia black; vertex with three black fasciæ, one on each side behind the eyes, and one central containing the ocelli and a small angulated black marginal spot near bases of antennæ; eyes dull castaneous. Pronotum olivaceous green, with a central longitudinal ochraceous fascia margined with black, a black submarginal fascia, and the extreme margin ochraceous. Mesonotum olivaceous green, with five longitudinal black fasciæ all more or less margined with ochraceous, situate one central and longest extending right across disk and attenuated anteriorly, on each side of this is a shorter fascia extending from anterior margin to about centre, followed again by a long and broader fascia a little before each lateral margin; a small black spot in front of the anterior angles of the cruciform elevation, which is also more or less olivaceous. Abdomen above piceous, more or less clothed with fine greyish pilosity, the tympana and some lateral shadings olivaceous. Head beneath and sternum olivaceous, frontal margin between the eyes black; sternum more or less greyishly pilose; legs olivaceous, an apical annulation to anterior femora, the under surfaces of intermediate and posterior femora, more than apical half of anterior tibiæ, and about apical third of intermediate and posterior tibiæ and the tarsi black. Opercula olivaceous, the inner margin and about apical two thirds (not quite reaching outer margin) black. Abdomen beneath piceous, more or less greyish pilose. Tegmina pale hyaline, narrowly olivaceous at extreme base, the venation alternately brownish olivaceous and piceous, the costal membrane olivaceous, two subapical piceous spots situate on the transverse veins at bases of the two upper apical areas, and some minute submarginal piceous spots. Wings pale hyaline, narrowly olivaceous at extreme base, the costal margin ochraceous for about half its length.

♂. Long. excl. tegm. 34 to 38 millim.; exp. tegm. 94 to 103 millim.

Hab. Penang (*Rev. L. C. Biggs*).

The opercula about, or almost, reach the base of the last abdominal segment, are concavely narrowed near base, and ampliated and rounded towards apex; the face is narrowly sulcated for about half its length and possesses strong transverse ridges; the anterior femora are armed with three spines beneath, one near centre, two near apex, the apical one smallest.

Pomponia promiscua, n. sp.

♂. Body above greenish ochraceous. Head with two small fuscous spots at apex of front and two wider apart at

base of front, the ocelli also surrounded with fuscous; the head is also mottled with very pale ochraceous, and the eyes are dark castaneous. Pronotum with the margins pale ochraceous, an indistinct central fascia margined with ochraceous, with an obscure castaneous spot on each side, and four oblique incisions on disk, two on each side of central fascia. Mesonotum with two obscure central obconical spots margined with greenish, the lateral margins and the basal cruciform elevation also of the same colour. Abdomen with the stigmata and the segmental margins castaneous. Body beneath ochraceous; apex of the rostrum, basal and apical annulation to tibiæ, apices of the tarsi, and penultimate abdominal segment castaneous. Tegmina pale hyaline, with talc-like reflexions; venation alternately ochraceous and fuscous; costal membrane and a small costal spot at base of upper ulnar area ochraceous, basal claval area greyish opaque; transverse veins at the bases of the second and third apical areas slightly infuscated. Wings as tegmina, but unspotted.

♂. Long. excl. tegm. 25 millim.; exp. tegm. 65 millim.

Hab. Sumatra (*Forbes*), March.

The body is moderately robust; the abdomen broad, narrowed at apex. The lateral margins of the pronotum are slightly sinuated. The face is broad and tumid, with a central and very obscure levigate carina, but not sulcated; transverse ridges not extending to apex. Rostrum just passing the posterior coxæ. Opercula very small, obliquely rounded, not reaching the basal segment of the abdomen.

This is one of a series of small species of *Pomponia* found in the Eastern islands. It is probable that the colour is, or often is, green, and not ochraceous, during life.

XXIV.—*On the Blood-corpuscles of the Cyclostomata.*

By Professor D'Arcy W. Thompson, Dundee.

It is commonly stated in the text-books, for example in Huxley's 'Anatomy of the Vertebrata' (p. 100), that the blood of the Cyclostomes differs from that of all other fishes in the *round* instead of *oval* shape of its red corpuscles. Gulliver, on whose authority most of the text-book statements concerning the size and shape of blood-corpuscles rests, says, in his edition of Hewson's works (p. 234), "In the Cyclostomes the corpuscles are of the same figure as those of Man, and only slightly larger." Accordingly I was more than a little surprised, on examining some living *Myxinæ* lately, to

find their red blood-corpuscles *large* and *oval*, and similar to those of the skate or dogfish. On consulting Johannes Müller (Vergl. Anat. d. Myxinoiden) I found that he had noted and figured the oval corpuscles of *Myxine*, but without measuring them or calling attention to their points of contrast with those of *Petromyzon*. Dr. Günther, in his article "Ichthyology" in the 'Encyclopædia Britannica,' says accurately that "the corpuscles of *Petromyzon* are round," but proceeds to say that the corpuscles of the Cyclostomes are exceptionally small, taking it for granted doubtless that the two genera agree in this respect.

I find the red corpuscles in *Myxine* to be thin, flattened, oval plates, with a central nucleus, which is sometimes round, more often elongated and rod-like.

Their dimensions are as follows:—

	millim.
Length	·025 to ·028
Breadth	about ·01
Thickness	„ ·003

The nuclei stain very quickly and intensely with magenta. The white corpuscles are of about the same size as those of man. They are irregular or amœboid in shape, and have a very large granular nucleus. Sometimes the whole corpuscle is granular, and then appears to be devoid of a nucleus. The white corpuscles are remarkably numerous, being not less than three fourths as numerous as the red, and sometimes equalling them in number.

In *Petromyzon marinus* I find the red blood-corpuscles to be circular, as stated. They measure about ·013 to ·014 millim. in diameter. Gulliver gives ·019 for *Petromyzon*; but he very probably used another species. The nucleus is small, placed not in the centre, but usually near the edge of the disk, and stains very slowly and feebly in magenta or hæmatoxylin. The white corpuscles are even more numerous than in *Myxine*, being actually thrice or four times as many as the red. Their nuclei are small and stain well, and forms transitional in shape and size to the red corpuscles seem to be recognizable. Some indeed are round, clear, with excentric nucleus, and similar in size to the red corpuscles; others are quite small, one half the diameter of the former, and with a central nucleus; others, again, are large, granular, and with the nucleus disproportionately large.

In both genera the red corpuscles are very easily deformed. The corpuscles of *Myxine* often seem to tail off into a point

at each end, and those of *Petromyzon* are often (especially in very fresh specimens!) irregular in outline.

We thus find that the blood differs in almost every point in these two animals, viz. in the size and shape of the red corpuscles and in the character of their nuclei, and that *Petromyzon* in these respects stands alone, while *Myxine* resembles other fishes, and especially the Elasmobranchs and Dipnoi, whose corpuscles are much larger than those of Teleostei. But the two genera agree in the extraordinary number of the white corpuscles, which in most fishes are, if anything, exceptionally scanty.

I did not take the opportunity of estimating the number of the red corpuscles in either case; but they are certainly exceptionally few, especially in *Myxine*.

One very curious point still remains. Shipley, in his recent paper on the development of *Petromyzon* (Quart. Journ. Micr. Sci., Jan. 1887), states, without further remark, that the red corpuscles of the Ammocœtes (*P. fluviatilis*) are oval; and in writing to me he confirms the statement that the corpuscles of the Ammocœte differ altogether in size and form from those of the adult *Petromyzon*. This observation is, I fancy, quite novel, and it recalls the similar but far less striking fact that the corpuscles of the young tadpole were long ago observed (by Gulliver) to differ somewhat in size and shape from those of the frog. But the noteworthy point now is that *Myxine* possesses red corpuscles similar to those not of the adult, but of the *larval* lamprey, which in many ways it resembles otherwise.

XXV.—*Note on a new Type of Compound Eye.*

By F. E. Beddard, M.A., F.Z.S.

The minute structure of the eye in the Cymothoidæ has been treated of by Johannes Müller *, and more recently by J. F. Bullar †; the observations of the older author principally concern the cuticular lenses and the vitreous body, and are immaterial to the present note. Bullar has described and figured the eye of *Cymothoa* in some detail; his results on the whole show no great difference from the eye of *Porcellio*, which has been investigated by Grenacher and described in

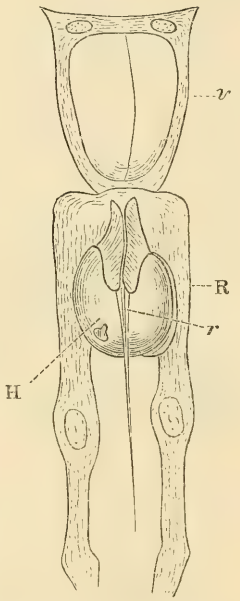
* Meckel's 'Archiv,' 1829.

† Phil. Trans. 1878.

his important memoir * on the Arthropod eye. The vitrella† in both types consists of two cells, which secrete a round or pear-shaped crystalline cone; this crystalline cone is evidently composed of two halves closely applied together, each half being formed from a single cell of the vitrella.

The retinula in both types is seven-celled; each cell secretes a chitinous refracting rod—the rhabdomere; these become fused into an axial structure—the rhabdom—in *Porcellio*; in *Cymothoa* each rhabdomere remains separate and within the retinula-cell of which it is a product.

I have recently studied the structure of the eye in several species of *Æga* and allied genera, and find some notable differences from the types already mentioned as well as from all other Isopods, excepting the genus *Serolis*. In *Serolis* ‡ the retinula differs from that of *Porcellio* &c. in being composed of only four cells; each cell secretes at its upper extremity a chitinous rhabdomere: the rhabdomeres are more or less completely fused together along their inner faces, but the rhabdom is not imbedded between the retinula-cells; on the contrary, each of these cells, owing to its peculiar shape, is only in contact with the upper part of the rhabdom; *the lower portion is surrounded by two large spherical transparent cells, which fit in closely between the four retinula-cells* (see woodcut). These cells are distinctly nucleated (H), the nucleus possessing a well-defined nucleolus. In sections it can be readily seen that the rhabdom, which at its inferior extremity becomes divided into four separate pieces (corresponding of course to the four rhabdomeres of which it is composed), is imbedded in, or at least is entirely surrounded by, the substance of these large clear cells.



Ommatidium of *Serolis Schythei*. *v*, vitrella-cells; R, retinula-cells; *r*, rhabdom; H, hyaline cells.

* 'Sehorgan der Arthropoden,' Göttingen, 1879.

† This term has been introduced by Profs. Lankester and Bourne (Quart. Journ. Micr. Sci. 1883, p. 177).

‡ "Report on the Isopoda collected during the Voyage of H.M.S. 'Challenger,'" Zool. Chall. Exp. pt. xxxiii.

In several species of Cymothoidæ I have been able to recognize the presence of these same hyaline cells both in sections and in teased preparations: I invariably found two present, and their relation to the retinula-cells and to the rhabdom was precisely as described above in *Serolis*. *Æga*, however, agrees with *Cymothoa* and other Isopods and differs from *Serolis* in the fact that there are seven cells to each retinula; but in the presence of these remarkable hyaline cells, as well as in their structure and position, *Æga* exhibits a striking resemblance to *Serolis*, and differs, so far as our knowledge goes, from all other Isopods. This structural resemblance between *Æga* and *Serolis* tends further to confirm the view, held by many carcinologists, of the close relationship between the Serolidæ and Cymothoidæ.

In one of my figures of the structure of the eye in *Serolis Schythei* (*loc. cit.* pl. ix. fig. 5) I have depicted the rhabdom as ending in a fine filament which passes through the hyaline cell as far back as the membrane which bounds the ommateum posteriorly; I have also (figs. 3, 4) noted a similar prolongation of the rhabdom in *Serolis cornuta*.

On again referring to my preparations of both these species I find that those figures are not quite accurate. In *Serolis Schythei* the rhabdom has not the conical form which I have erroneously given to it in my drawing; it ends in four blunt points (*cf.* woodcut): just below the termination of the rhabdom is a bundle of delicate fibrils which unite into a single fibre (*r*); this passes through the substance of the hyaline cells and can be traced back as far as the ommateal membrane. In *S. cornuta* the arrangement is identical.

In some young examples of *S. Schythei*, taken from the brood-pouch of the mother, this bundle of delicate fibres, terminating in a single long fibre, was present, and appeared from its position to be a product of the four pigmented retinula-cells. At this stage the thickened masses which form the greater portion of the rhabdom in the adult eye were not developed. If it were not for this fact the bundle of fibrils (*r* in woodcut) in the adult eye would seem to have nothing to do with the rhabdom of the pigmented retinula-cells, but to be anteriorly formed by the hyaline cells. It is indeed quite possible that it is in part formed by these cells. If this be so, the retinula in Serolidæ and Cymothoidæ is composed of six cells, two transparent cells surrounded by four pigmented cells, all of which secrete chitinous rods. The central transparent cells, however, do not appear to end in nerve-fibres, unless the axial chitinous rod contains nerve-fibrils, which is of course a mere suggestion.

The structure of each retinula is therefore clearly very similar to that of the retinula of many mollusks as described by Patten, and, which is more important for purposes of comparison, to *Nereis* among Annelids if Patten's interpretation * of Carrière's figures be allowed. The two central clear cells are Patten's 'retinophoræ.' It will be observed, however, that apart from these two problematical hyaline cells the minute structure of the eyes of the Serolidæ and Cymothoidæ bear out Grenacher's conclusions rather than Patten's with regard to the morphology of the Crustacean eye. There can be no doubt that the crystalline cone is independent of the rhabdom and formed by different cells.

The specialization of the retinula-cells is, however, a new feature, and distinguishes the eye of these Isopods.

XXVI.—*Note on the Hapuku of New Zealand* (Polyprion prognathus). By Dr. A. Günther, F.R.S.

The Hapuku of New Zealand, one of the most highly esteemed food-fishes of the southern hemisphere, and attaining to a weight of 100 pounds, has been known to naturalists since Cook's visits to that country, as has been shown by Mr. Hutton (Trans. N.-Z. Instit. v. p. 259). It was figured by Forster as well as by Parkinson, the former naming it *Perca prognathus*, a very appropriate term, to which I give preference before all others, although Schneider (Bl. Schn. p. 301) arbitrarily changed it into the less expressive *Epinephelus oxygeneios*. Forster's original description is published in 'Descript. animal. ed. Lichtenstein,' p. 309, and referred to by Cuvier (Cuv. & Val. Hist. Nat. Poiss. iii. p. 29), who, with his perfect knowledge of fishes, recognized its relation to *Polyprion*, not doubting that it was the same species as the Atlantic *P. cernium*.

The figure left by Parkinson bears the name *Sciæna gadoides*, probably in Broussonnet's handwriting; but this name seems to have remained always a MS. name.

The second period of the history of this fish begins with Owen, who, in the 'Osteological Catalogue of the College of Surgeons,' i. p. 51, described the skeleton of a New-Zealand Percoid under the name of *Centropristis gigas*. In the 'Catalogue of Fishes,' i. p. 251, I stated the reasons which

* Mitth. Zool. Stat. Neapel, 1886.

prevented me from adopting Professor Owen's view as to the generic affinity of this fish, which I thought, in the absence of specimens preserved entire, would prove to be rather with the Murray cod, *Oligorus*; and thus the fish appeared in nearly all subsequent publications as *Oligorus gigas*. Castelnau, however ('Notes on the Edible Fishes of Victoria,' 1873, p. 8, and Proc. Zool. Soc. Vict. ii. 1873, p. 151), proposed to form a new genus for it, *Hectoria*, "on account of its armed tongue, double-pointed operculum, &c."

In more recent years the same fish has been found far from the place of its first discovery, viz. off the island of Juan Fernandez, and described by Steindachner as *Polyprion Kneri* (Sitzungsb. Wien. Acad. lxxi. p. 443); also the 'Challenger' obtained it off the same island (Chall. Shore Fish. p. 24).

Finally, the British Museum obtained from the Fisheries and Indo-Colonial Exhibitions specimens (in spirit as well as mounted) from New Zealand and Juan Fernandez *; and a direct comparison of these specimens can leave no doubt that all belong to the same species, which is antipodal to the only other species known, *Polyprion cernium*.

Lowe (Fish. Madeira, p. 185) has shown that *P. cernium* is a deep-sea fish, swimming near the surface when young, but living habitually at a depth of 300 and more fathoms when adult. The wide range of this genus is therefore not surprising; in fact we may well expect that *P. cernium* will be met with far beyond the limits of the north-eastern Atlantic.

XXVII.—*On Australian Fishes of the Genus* Beryx.

By Dr. A. Günther, F.R.S.

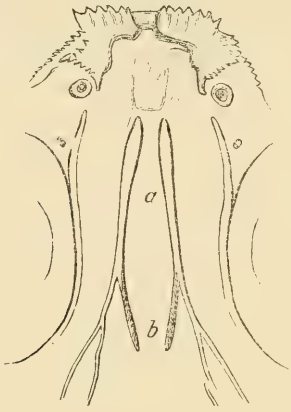
The British Museum has recently acquired, in a collection of fish from Adelaide, a fine specimen of *Beryx*, which, although closely allied to *Beryx affinis*, is clearly specifically distinct from it, differing somewhat in the fin-formula, in the size of the scales, and especially in the form of the nostrils and the sculpture of the opercles and of the upperside of the head. It may be named

* Those exhibited by the Chilian Government, and presented by them to the British Museum, bore the MS. name "*Perca fernandeziana*."

Beryx Gerrardi.

D. $\frac{6}{13}$. A. $\frac{4}{12}$. V. 1/7. P. 14. L. lat. 37.
L. transv. 6/12.

The height of the body is contained twice and one fourth in the total length, without caudal; the length of the head twice and three fifths. Operculum crossed by parallel raised lines, which also extend over the surface of two flat prominences, which take the place of spines proper; præoperculum



armed with a series of very small spines at its rounded angle. The two median ridges (*a*) of the interorbital space are subparallel and do not join in front; they bifurcate behind, the inner branches (*b*) being strongly convergent. Eye more than one third of the length of the head. Nostrils two small openings, separated by a broad bridge. Pectoral fin shorter than the head without snout; caudal fin deeply cleft. Coloration uniform.

Length of the single specimen 13 inches.

For comparison I will add the diagnosis of *Beryx affinis*.

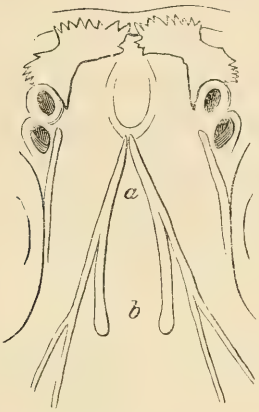
Beryx affinis.

Beryx affinis, Günth. Fish. i. p. 13; Hutton, Ann. & Mag. Nat. Hist. 1877, xix. p. 341.

D. $\frac{7}{12}$. A. $\frac{4}{12-13}$. V. 1/7. P. 13. L. lat. 41–47.
L. transv. 6–7/12–13.

The height of the body is contained twice and one fourth

in the total length without caudal; the length of the head twice and two thirds. Operculum crossed by parallel raised lines and armed with two strong, flat, and smooth spines; angle of the præoperculum armed with similar spines, of which one is much stronger than the others. The two median ridges



(*a*) of the interorbital space converge and join in front; they bifurcate behind, the inner branches (*b*) being parallel. Eye two sevenths of the length of the head. Nostrils wide, open, separated by a very narrow bridge. Pectoral fin longer than the head without snout. Caudal fin deeply cleft. Coloration uniform.

We possess specimens from Sydney and Hobart, the largest being 15 inches long. This species seems to extend also to the coast of New Zealand.

Beryx lineatus.

Beryx lineatus, Cuv. & Val. iii. p. 226; Günth. Fish. i. p. 13.
Beryx Mülleri, Klunz. SB. Ak. Wiss. Wien, 1880, lxxx. p. 359, Taf. iii. fig. 1.

Of this species we have received a very fine example from Adelaide, which shows that the fish described by Klunzinger cannot be separated from the Cuvierian species. I take this opportunity of correcting an error in the 'Catalogue of Fishes' (*l. c.*), where King George's Land is printed for King George's Sound.

XXVIII.—*Descriptions of new Species of Lepidoptera from the Solomon Islands, collected by C. M. Woodford, Esq.* By A. G. Butler, F.L.S., F.Z.S., &c.

Geometrites.

Euschemidæ.

1. *Euschema pilosa*, sp. n.*

Nearest to *E. tyrianthina* in pattern, but with the orange and grey body of *E. fenestrata* and allies: wings deep purple, banded and spotted with black; the veins pale: primaries of male crossed by two paler purplish bands, enclosing an abbreviated streak of the same colour; these bands are formed much as in *E. cyane* of Cramer, but the outer band is further from the margin: secondaries pale towards the base and with a narrow paler oblique band, followed by a small spot, before the middle; in the female all these markings are white instead of purplish; an irregular series of submarginal orange crescents somewhat as in *E. tyrianthina* or *E. cyane*, but more or less obliterated and further from the margin; as in the allied species, these crescents are broader in the female than in the male. Front of thorax purplish black; the head (excepting an orange semicircle round each eye) and antennæ dark brown; in the female, however, the face is whitish and the vertex of head and the antennæ are pale brown; the collar and tegulæ are sprinkled with brown hairs, and the thorax is whity brown; the back part of the thorax in the male is darker and clothed with brown and grey hair: abdomen pale brown, barred with reddish, with the sides and anal extremity woolly and bright dark orange in the male; the dorsal surface of the last two segments often ornamented with large blue-black spots; in the female the sides and anal extremity are smooth and bright ochreous. On the under surface the markings are broader and better defined and the veins whiter; pectus of male blackish, excepting a few orange hair-scales at the sides; legs purplish, slightly sprinkled with white and ochreous scales; venter woolly, deep bright orange; pectus and legs of female dust-grey; venter of the same colour, but with yellow edges to the segments and with orange anus. Expanse of wings 92 millim.

Five males and one female. Shortland Island.

* Belongs to the section to which the name *Heleona* has been given.

2. *Ctimene excellens*, sp. n.

Apparently intermediate between *C. xanthomelas* and *C. aurinata*: primaries with the basal two fifths, excepting the extreme base and costa, which are black, bright cadmium-yellow, separated by a broad, oblique, black belt from an irregular, cadmium-yellow, discal belt (shaped like an eagle's head, with the beak pointing downwards); outer border black: secondaries bright cadmium-yellow, with rather broad, black, external border, widest towards costa; the costa grey from apex to middle, but divided by a yellow spot at the margin of the outer border and united to a black subcostal spot in the cell. Body black; an ochreous stripe commencing on each side of the collar, encircling the neck below and continued down the anterior coxæ; the palpi of the same colour; the under surface of the anterior tibiæ pale buff. Expanse of wings 36 millim.

Ulaua and Tyoh, Malayta.

There can be little doubt that this and the species referred to above are strictly congeneric with Boisduval's type of the genus, but they do not correspond with the characters laid down by Mr. Meyrick for the recognition of the genus. This, then, is the proper place to express my strong disapprobation of the plan adopted by that author when characterizing genera of the Australian region, viz. to identify a similarly shaped or coloured Australian species with description or figure and to characterize the genus from it instead of from the type. In a case like the present it is probable that the typical species could not be obtained; but in the case of *Spilosoma* and many other genera incorrectly characterized by Mr. Meyrick from Australian species no such excuse exists; I hold that in all such cases considerable hindrance, instead of assistance, is offered to the advancement of knowledge.

Uraniidæ.

3. *Lyssidia mutata*, sp. n.

Allied to *L. patroclus* and *L. Goldiei*; colours the same; wings crossed by a rather narrow white band, slightly wider than the pale brownish band of *L. patroclus*, but placed further from the outer margin, and the band of primaries decidedly more oblique than in *L. patroclus*; primaries of male above slightly purplish; other characters variable, as in the allied species. Expanse of wings, ♂ 149 millim., ♀ 144.

Alu.

Œnochromiidæ.

4. *Decetia insignis*, sp. n.

♂. Nearest to *D. subobscurata* (*Gynopteryx subobscurata*, Walk.): primaries above sandy ochreous, sparsely speckled with dark grey, most densely at apex; a spot of dark grey at the end of the cell and three small, ill-defined, greyish patches in the form of a triangle, one on apical fifth of costa, a second near the middle of the outer margin, a third near the middle of the first median interspace; a slender, oblique, brownish line from just before the middle of the inner margin to the apex; a submarginal series of five grey-speckled white dots towards apex; fringe brown: secondaries with greyish-white costal area, mottled with grey towards apex; remainder of wing ochraceous at base, this colour being limited at basal fourth by a short brown line, thence to middle greyish flesh-coloured; discal third ochraceous, partly interrupted and bounded externally by an irregular streak of five very unequal pitch-brown spots, the second of which is large, quadrate, and placed obliquely; external fourth greyish flesh-coloured, with deep ochreous outer margin; fringe brown. Vertex of head and stem of antennæ whitish, pectinations brown; thorax flesh-tinted; abdomen grey-brown. Under surface flesh-pink, densely mottled with minute grey striations; venter whitish. Expanse of wings 47 millim.

Alu.

In the same collection is a second *Decetia*, from Shortland Island, which agrees so closely with *D. numicusaria* that I have no doubt of its being the male. The locality "S. America" was on the specimen described by Walker; but even he was aware that this was an error. No locality was given in the register.

Boarmiidæ.

5. *Ophthalmodes parva*, sp. n.

♀. General appearance above of *O. herbidaria*; white, irrorated and striped with olive-green as follows:—two indistinct subparallel lines across the basal half; an arched band enclosing a regular zigzag white line beyond the middle, and a marginal band, enclosing along its innner edge a series of whitish lunules; three series of black dots, the first along the inner edge of the postmedian white stripe, the second on the inner edge of the submarginal lunules, the third marginal: primaries also with a black dot near the base of the median

vein, three on the subbasal olivaceous line (the first being costal), and three, of which the middle one is large and represents the reniform spot, on the second olivaceous line: secondaries with a dark olivaceous white-pupilled spot at the end of the cell. Under surface smoky grey; all the wings with a large black spot at the end of the discoidal cell, a very indistinct angular dusky line just beyond the middle, a broad dusky area occupying the external third, a spot on outer margin, and an irregular external border (with which this spot is confluent) snow-white: primaries with a large, diffused, subapical, black patch: secondaries with a smaller and less distinctly black subapical nebula. Expanse of wings 49 millim.

Ulaua.

This is the smallest species known to me.

Geometridæ.

6. *Agathia pisina*, sp. n.

Nearest to *A. hemithearia*; wings bright pea-green, banded with reddish coffee-brown and plum-colour, these bands traversed by dentate-sinuate, silvery lines and interrupted by spots nearly as in that species; it differs as follows:—all the bands much redder, the external belt or border of primaries narrowed behind almost as much as in *A. discriminata*; the subapical green patch abruptly narrowed at the back of the first spot of the subapical series and extended outwards to the margin; the third spot large, and all three confluent, as in *A. discriminata*; fourth spot silvery, large, but not confluent with the others; fifth and sixth spots small, green, placed obliquely; a bisinuate inner stripe, three marginal spots, and the veins at apex distinctly silvery; costal border much broader than in either of the above-mentioned species and silvery; the band crossing the wing before the middle also broader and much more angular; external area of secondaries formed and ornamented as in *A. discriminata*, but nearly as broad (excepting towards anal angle) as in *A. hemithearia*; front of head whitish, with a reddish-brown anterior transverse band and plum-coloured lines round the bases of the antennæ, the latter ferruginous internally, whitish externally; vertex of head and thorax pea-green; tegulæ with reddish-brown margins and long brownish terminal hairs; abdomen reddish brown, with white sides and pale dorsal spots, two of which (on the basal half) are pea-green.

Under surface like *A. discriminata*, but with broader plum-coloured bands. Expanse of wings 44 millim.

Alu.

There is so much general similarity between the species of this beautiful group that an ordinary description would probably be insufficient to identify it by; I have therefore preferred to give a comparative description, showing in what points it differs from two well-known species.

Palyadidæ.

URANODOXA, gen. nov.

Allied to *Ophthalmophora*; with the same arrangement of nervures, but the wings shorter and broader; the body much more robust, with coarsely pectinated and extremely long antennæ reaching to about the fifth sixth of the costal margin of primaries; the body scarcely longer than the antennæ, with wide short head; palpi broad and compressed, with well-exposed terminal joint; legs much stouter than in *Ophthalmophora*, the last pair armed with four strong spurs in pairs.

7. *Uranodoxa longicornis*, sp. n.

Primaries above with the basal three fourths flesh-tinted, transversely streaked with plum-colour in front, greyish brown behind, the whole surface transversely striated with black and crossed by three dull plum-coloured bands, of which the outermost is very broad towards costa and gradually tapers to inner margin: secondaries with the basal two thirds golden ferruginous, striated with black, and with a black discocellular spot; all the wings with the external border bright orange, with spots at regular intervals formed by pyramidal groups of black striæ; this border is bounded internally by a brilliant scarlet band, followed by an almost confluent series of grey-edged metallic silver spots; along the outer margin is a bronze or tarnished silvery stripe, followed by grey-tipped plum-coloured fringes; antennæ brown, with a slender, white, lateral line: body brown, washed with purplish plum-colour; abdomen with whitish margins to the segments, ochreous sides, and white tip to the anal tuft. Under surface deep ochreous: primaries crossed from just before the middle by three blackish lines, the central one wide and limiting a broad, grey-brown, external area, which is nevertheless interrupted towards inner margin by two unequal spots of the ground-colour: secondaries with a squamose blackish costal spot and a dot at the end of the cell; an

external brown area, only half as wide as in the primaries, interrupted by one large spot close to abdominal margin and bounded internally by a wide blackish stripe; anal tuft of abdomen coloured much as above. Expanse of wings 35 millim.

Alu.

This superbly coloured moth must either stand between the genera *Palyas* and *Dissophthalmus*, or between the latter and *Ophthalmophora*.

Ephyridæ.

8. *Anisodes pauper*, sp. n.

Allied to *A. absconditaria*, pale pink; wings above crossed obliquely by greyish stripes and sparsely irrorated with blackish scales: primaries crossed in the middle by two divergent stripes, the inner one arched, the outer acutely angulated towards each extremity so as to form a long Z; two angulated and zigzag submarginal lines, the inner one regularly dotted with black; a marginal series of black dots, one or two towards the base and one at the end of the cell: secondaries crossed near the base by an abbreviated line on which are two black dots; a central diffused stripe and two narrower discal stripes parallel to outer margin, the inner of these stripes regularly edged externally with black points; a marginal series of black dots; abdomen rather more pink than the thorax. Under surface sericeous creamy white; wings with small dusky discocellular spots; a discal zigzag series of black dots, and a slender zigzag brown marginal line; anterior tibiæ brown above. Expanse of wings 38 millim.

Malayta.

This is about the most indistinctly marked species in the genus, the stripes being about as much pronounced as in the British *Idæa strigilata*, rather less than more so.

Idæidæ.

9. *Ochodontia subochrea*, sp. n.

♂. Above pale sericeous golden buff; primaries indistinctly speckled with grey on the costa; a small sandy testaceous spot at the end of the cell and a straight oblique stripe from apical seventh of costal to external third of inner margin; an imperfect dark brown edging to the apical sinus: secondaries with a small silvery white spot at the end of the cell and a straight oblique sandy testaceous stripe across the middle: head dark brown; pectinations of antennæ grey;

thorax greyish, especially behind; abdomen slightly brownish behind. Under surface clear ochreous; wings sparsely irrorated with minute slaty purple striations; primaries with an abbreviated purple transverse streak beyond the middle of internal area, inner border white; all the wings with a submarginal purple line; hind tibiæ with reddish fringes. Expanse of wings 35 millim.

Alu.

Nearest to *O. aventiaria*.

10. *Zanclopteryx ætherialis*, sp. n.

Nearest to *Z. fragilis*: pearly white, wings crossed towards outer margin by an irregular series of brown dots and dashes, as in *Z. guttilinea* of Java; a squamose lunulated brown line and a marginal series of black dots: primaries with the costal border more or less striated with brown; a black spot at the end of the cell: secondaries with a brown spot at the end of the cell. Wings below with only the discocellular markings. Expanse of wings 19–20 millim.

Alu, Shortland Island.

Some examples are more strongly marked than others.

Micronidæ.

11. *Strophidia costalis*, sp. n.

Allied to *S. bifasciata*, but differing in the white costal border of the primaries and the broad white external border of the secondaries; above snow-white: primaries with a black-brown subcostal band continued as a black-brown border round the outer margin; two well-separated pale brown bands across the middle of the wing from the subcostal band to the inner margin: secondaries crossed from just before the middle of costa to the anal angle by a pale brown band, which unites upon the abdominal margin with an angular darker brown discal band, parallel to outer margin; three increasing black oval spots from anal angle to base of caudal projection, the fringe of this part of the wing also black. Head, excepting the face and the lower surface of the palpi, black; remainder of body white; anterior tibiæ and tarsi blackish above. Primaries below white; a pale brown abbreviated stripe just beyond the cell and a spot in the cell; apex and outer margin darker brown; fringe blackish: secondaries nearly as above, but the outer brown band widened and dentate-sinuate towards anal angle, so as to completely obliterate the black spots. Expanse of wings 57–59 millim.

Three examples. Shortland Island.

The following form I name with some hesitation; for although Mr. Meyrick, to whom I showed it, expressed his opinion that it was distinct from *S. urapterina*, I still feel some doubt about it*.

12. *Strophidia hyemalis*, sp. n.

♂ ♀. Quite like a small edition of *S. urapterina*, but with the brown bands slightly paler, more oblique, narrower, and of more equal width; no short brown stripe at the end of the cell of primaries. Expanse of wings 44 millim.

Two examples. Alu, Shortland Island.

S. urapterina from the same island measures 58 millim. in expanse of wing, and differs in no respect from the typical New-Ireland form.

Larentiidæ.

13. *Remodes volcanica*, sp. n.

Primaries dark greenish sulphur or mustard-yellow, crossed by five bands, the first two indistinct, formed of about three olivaceous stripes which converge and unite in a brown spot on the submedian vein; third band wider, more distinct, formed of three wavy parallel stripes marked with brown beyond the cells and towards inner margin; fourth band formed of two similarly-marked stripes; fifth band or external border olivaceous, with black-spotted zigzag inner edge; outer margin with six black spots placed alternately with the submarginal series; fringe pale yellow, tipped with olivaceous: secondaries sericeous greyish brown; fringe slightly yellowish at base: thorax greenish yellow; antennæ brownish; abdomen whity brown, with greenish dorsal region. Under surface pale sericeous brownish grey; pectus, femora, and tibiæ yellow, tarsi dark brown. Expanse of wings 42 millim.

Shortland Island.

MISCELLANEOUS.

On the Structure of the Branchia of the Prosobranchiate Gasteropods. By M. Félix Bernard.

My investigations have been directed to numerous genera belonging to various families of Scutibranchiata, Tænioglossa, Rhachiglossa, and Toxiglossa. They have enabled me to study in detail the

* I quote my friend Meyrick's authority here because in the matter of species he is rather inclined to associate allied forms under one specific name, sometimes to an extent that is perfectly astounding.

elements which compose the branchial lamellæ, and to establish the identity of the structure of these organs in all the types examined, whether they belong to the type of unipennate branchiæ or to that of bipennate branchiæ.

1. The *epithelium* of the branchia always appears formed of two kinds of elements—of *columnar cells* inserted upon the basal membrane by a slender, sometimes ramified process, and terminated at the other end by a ciliated disk; the disks of contiguous cells touch one another, so as to form a regular and continuous mosaic, beneath which, between the groups of the preceding cells, occur small spherical or ovoid masses of *muciparous cells*. The epithelium of the mantle and of the false branchia also presents these two kinds of elements.

2. The *basal membrane* of the epithelium forms upon each surface, along the inner margin in the unipennate branchiæ, a resistant thickening of triangular section, which is the supposed supporting *cartilaginous rod*. This thickening is formed of superposed layers and presents no trace of cells. It is therefore not cartilage, as has so often been said.

3. Between the two laminæ of the basal membrane there are *stellate cells* with anastomosing processes, sometimes isolated, sometimes collected into groups, especially near the margins, where they are sometimes arranged with regularity. This is the ordinary connective tissue of the lacunæ.

4. A bundle of longitudinal *muscular fibres* extends quite to the point; from it are detached fibres which run obliquely towards the outer margin.

Other fibres, transverse and often distinctly ramified at their extremity, are less constant in their occurrence and arrangement. This is the case also with another system of longitudinal fibres, sometimes forming a close grating with the preceding. All these fibres meet on both sides of the central lacuna.

The innervation of the branchia compared with that of the false branchia will be the subject of another communication.

With regard to the circulation, I have been led to resume the recent researches of MM. Wegmann and Boutan. These anatomists have indicated, one of them in *Haliotis*, the other in *Fissurella*, the existence of vessels in each margin of the lamella and united by transverse capillaries. Numerous injections, sections, and transparent preparations obtained by removing the epithelium by reagents enable me to assert that in these two genera, as in all those which I have hitherto studied, there are neither vessels nor capillaries—that is to say, there is no canal circumscribed by a muscular or endothelial coat.

According to M. Boutan *, "the lamellæ are formed of a spongy tissue filled with little lacunæ, the excessively minute size of which must cause them to be assimilated to capillaries." Now any assimilation of lacunæ, however small they may be, to capillaries,

* Arch. de Zool. expér. sér. 2, tome iii., Suppl. p. 37.

seems to me contrary to what we know most precisely of the morphology of the circulatory apparatus.

On the other hand, M. Wegmann had previously figured * and described, in more detail than M. Boutan, a complicated system of capillary vessels in *Haliotis*. Now H. Milne-Edwards long ago announced that the organs of the Gasteropoda (except perhaps the renal organ) always present lacunæ and no capillaries. It was therefore interesting to ascertain whether the branchia formed an exception to this rule.

By injections I have had no difficulty in reproducing the appearances figured by M. Wegmann; but I explain them by the well-known foldings of the lamella and also by the nearly regular arrangement in line of the connective cells or groups of such cells. The supposed vessels of the two margins are only portions of the lacuna in which the connective tissue is sparse and in which, consequently, the injected material circulates easily.

The space within the double basal membrane is therefore nothing but a simple diverticulum of the general lacuna, which extends between the two laminæ of the mantle. My investigations thus confirm the views of Milne-Edwards.

I may add that in the Aplysiidæ and Bullidæ the branchia is formed by the more or less complicated folding of a single lamella, the structure of which is the same as that just described for the pectinate branchiæ.—*Comptes Rendus*, August 8, 1887, p. 316.

Description of a newly-excluded Young of the Ornithorhynchus paradoxus. By Sir Richard Owen, K.C.B., F.R.S., &c.

Of this interesting and long-hoped-for discovery the author was informed by his friend and correspondent, the Baron von Müller, F.R.S., of the Botanical Gardens, Melbourne, and shortly received the specimen from the Baron: also further details from Mr. Le Souef, of the Zoological and Acclimatisation Society's Office, Melbourne; and from the Rev. Pastor Hagenauer, Superintendent of the Missionary Station in Gipps-Land, S.E. Victoria, to whose influence with the natives science is indebted for the acquisition, as I am to Baron von Müller for the reception, of the embryo well preserved in alcohol. The specimen is nude, an inch in length, the nostrils well opened, and between them the fleshy conical support of the horny sheath, which has been shed and by which the chorion had been torn open at birth. The mouth is a transverse slit, not produced as a beak, bounded by flexible lips, and sufficiently open to receive nutriment afforded by the group of pores excluding the secretion of the mammary gland of the pouch. The fore limbs, chiefly represented by the paws and pentadactyle, with claws sufficiently developed for adhering to the part of the pouch on which the excretory pores open. The hind limbs are less developed, have

* *Ibid.* sér. 2, tome ii. pl. xix.

the five digits feebly indicated and clawless. A short conical-pointed tail projects between them. The elongate, flattened, natatory tail of the adult is a later development. There is no trace of navel. The skin of the trunk is uniformly smooth and nude.

If this embryo should be a male, the spur of the femoral gland is a defensive organ of later growth.

The author refrains from dissection in hopes of receiving another specimen; and, after a detailed description of the external characters of the unique specimen, refers to his paper "On the Uterine Ovum of the *Ornithorhynchus*" in the volume of the 'Philosophical Transactions' for 1834, and on the "Mammary Glands" in the volume for 1832.—*Proc. Royal Soc.* vol. xlii. no. 256, p. 391.

Aulax hypochæridis, *a new Gall-fly*. By J. J. Kieffer.

Hypochæris radicata, L., frequently bears elongated or fusiform, or sometimes rounded swellings of the stem, which may attain a length of over an inch and a half and a width of over a quarter of an inch. They have the outer surface smooth and of the same colour and texture as the stem of the plant; internally they are spongy, white, with ten or twelve round or oval, pretty regularly arranged cavities, about one twelfth inch apart, within each of which a larva resides. They are therefore very like the galls of *Aulax hieracii*, Bouch., which occur frequently upon species of *Hieracium*; but the latter are always stouter, and their cells are larger and placed closer together, and form more than one row. These swellings usually occur below the forked branching of the stem; the shoot above them is sometimes normally developed, sometimes aborted. They are found as early as the beginning of June (in Austria), but are not mature until the autumn.

These galls have been obtained by the author in the neighbourhood of Bitsch, but they were first observed near Naples by Prof. Licopoli ('Le galle della flora di alcune province Napolitane,' Naples, 1877). Dr. Vice found them in North Wales, according to Trail ('Scottish Naturalist,' vol. iv. p. 16), and they were referred to by Dr. F. Löw in his "Bemerkungen über Cynipiden" (in Verhandl. zool.-bot. Gesellsch. in Wien, 1884, p. 326); Löw received specimens from Prof. Licopoli, and bred from them two females of the Chalcidian *Eurytoma cynipsea*, Boh.

From his specimens the author bred true gall-flies which he regards as forming a new species of the genus *Aulax*; they emerged in the spring (probably in May); in a heated room as early as February.

The species is named *Aulax hypochæridis* by the author, who describes the female, the only sex known, as follows:—"Body black. Antennæ filiform, with fourteen distinctly separated joints, dull black, with adpressed grey hairs; third joint somewhat longer than the fourth, both longer than the following ones, which are cylindrical, and about twice as long as broad; apical joint pointed. Face

striated. Forehead and vertex shagreened. Thorax moderately shining. Mesonotum nearly naked, only beset with a few short grey hairs, finely but distinctly wrinkled, the wrinkles forming very regular quadrangular cells. Scutellum with no median longitudinal furrow, at the base with two large pits, in its anterior half with the same sculpture as the mesonotum. Wings hyaline, fringed, with a radial area open on the outer margin, and with a distinct areola. Legs reddish yellow; apical joint of the tarsi and base of the trochanters black. Abdomen very shining, quite black."

Length of the female 2·1–2·2 millim.

Verhandl. zool.-bot. Gesellschaft in Wien, 1887, p. 205.

Anatomy and Histology of the Salivary Glands in the Cephalopoda.
By M. L. Joubin.

The existence in the Octopod Cephalopods of two pairs of salivary glands has been long known—one situated in the abdominal cavity, the other close to the buccal bulb, the latter being deficient in the Decapods. The author has, however, ascertained the presence of the second pair in the latter, but it is fused into a single, median, unpaired gland, situated beneath the œsophagus, and intimately mixed with muscular bundles. This gland, by its structure and the position of its excretory gland, is the homologue of the bulbar glands of the Octopods.

In the Poulpe (*Octopus vulgaris*) M. Livon has recognized the existence of a gland lining one of the surfaces of the tongue, but he could not find its excretory duct. The author has found this gland in all the Cephalopoda examined by him; it consists of a sort of sheet of *acini*, all opening into the space which separates the tongue from the mandible and forms part of the buccal cavity. This explains why M. Livon could not find any excretory duct.

Among the Octopods (*Octopus*, *Eledone*, *Argonauta*) the extra-bulbar salivary glands are situated in large lacunæ, into which the blood flows through very slender arteries, starting very symmetrically from the first division of the aorta by a single trunk on each side. This divides almost immediately into two branches, of which the superior traverses the head and runs to the pair of bulbar glands, while the inferior one descends vertically to the abdominal pair. The blood which they convey becomes diffused between the glandular elements, reaches the periphery, and falls into the great sinus by a multitude of pores, which are the intervals of the superficial *acini* or of the glandular tubes in the case of the abdominal gland.

In the Decapods (*Sepia*, *Loligo*, *Sepiola*, *Rossia*) they are not bathed in the blood-sinus, but the blood which has traversed them is collected by a venous network which unites with the great vein. The arteries are larger than in the Octopods, but their arrangement is less constant.

Sections of the glands taken from the living animal and very carefully prepared with osmic acid showed that in all Cephalopoda

the lingual gland, the unpaired subœsophageal gland of the Decapods, and the extra-bulbar pair of the Octopods are constructed upon the same type; they are bunches of *acini* formed by rather short cylindrical cells, filled in their inferior third with protoplasm with a large nucleus; the protoplasm is continued as a network in the middle third, and the rest is filled with rather large granules, which stain strongly. They much resemble the serous cells of Vertebrates. On the other hand, the pair of abdominal glands consist of large conical cells, the narrow lower part of which contains protoplasm, while the upper two thirds are filled with large balls of mucus, which does not stain with the same reagents as the inferior third; these large caliciform cells emit through their wide apertures the balls of mucus which become fused into a uniform mass in the excretory ducts, showing a remarkable analogy with the mucous cells of the higher Vertebrata.

The above is the fundamental structure of the salivary elements, but their arrangement differs greatly in the two great divisions of the Cephalopoda. In the Decapods the abdominal gland is small and formed of *acini*, like the other glands; but in the Octopods it is very large, and it is a tubular gland which may be broken up by the action of chloride of gold. It is formed by a tube indefinitely divided dichotomously, nearly equal in diameter throughout its whole extent, except in the final branches, which are smaller. The terminal tubular branches are clothed with a single layer of muscular fibres forming very regular and well-marked rings, the action of which is clearly to drive the mucus towards the excretory duct. All the tubes are twisted together inextricably, the spaces between them being occupied by connective fibres, large stellate cells, or free spaces through which the blood circulates.

The author adds that he has investigated the embryogeny of these glands and completed the researches of Bobretzky in many points.—*Comptes Rendus*, July 18, 1887, p. 177.

Habitat of Peripatus Leuckarti. By Prof. F. Jeffrey Bell.

Dr. E. P. Ramsay, F.R.S.E., has lately been so kind as to send me two specimens of *Peripatus Leuckarti*, Sänger. Prof. Leuckart's only information with regard to the place of origin of his specimen was "Neu Holland." It may therefore be of interest to state that Mr. Ramsay's examples were taken in the Queensland Scrubs, near Wide Bay. Sänger's paper being almost inaccessible, and, moreover, being written in Russian, I am glad to be able to add that Mr. Adam Sedgwick, F.R.S., will incorporate observations on the specimens sent me by Mr. Ramsay in his forthcoming monograph on the genus. Now that Mr. Ramsay has led the way, it is to be hoped more specimens of *Peripatus* may be sent from Australia to this country.

CONTENTS OF NUMBER 117.—*Fifth Series.*

Page

XVI. The Sponge-fauna of Madras. A Report on a Collection of Sponges obtained in the Neighbourhood of Madras by Edgar Thurston, Esq. By Arthur Dendy, B.Sc., F.L.S., Assistant in the Zoological Department of the British Museum. (Plates IX.–XII.) 153

XVII. On the *Pyrochroidæ* of Japan. By George Lewis, F.L.S. 165

XVIII. On a new Species of *Semionotus*, from the Lower Oolite of Brora, Sutherlandshire. By A. Smith Woodward, F.G.S., F.Z.S., of the British Museum (Natural History). (Plate VII.) 175

XIX. Description of a new Genus of Chalcosiid Moths allied to *Pedoptila*. By Arthur G. Butler, F.L.S., F.Z.S., &c. 180

XX. Bryozoa from New South Wales, North Australia, &c. By Arthur Wm. Waters.—Part II. (Plates V. & VI.) 181

XXI. *Polyparium ambulans*, a new Cœlenterate. By Dr. A. Korotneff. (Plate XIII.) 203

XXII. Description of a new Genus and Species of *Polyzonidæ*. By R. Innes Pocock. (Plate XIV.) 222

XXIII. Descriptions of new Species of *Cicadidæ*. By W. L. Distant 226

XXIV. On the Blood-corpuscles of the Cyclostomata. By Prof. D'Arcy W. Thompson, Dundee 231

XXV. Note on a new Type of Compound Eye. By F. E. Beddard, M.A., F.Z.S. 233

XXVI. Note on the Hapuku of New Zealand (*Polyprion prognathus*). By Dr. A. Günther, F.R.S. 236

XXVII. On Australian Fishes of the Genus *Beryx*. By Dr. A. Günther, F.R.S. 237

XXVIII. Descriptions of new Species of Lepidoptera from the Solomon Islands, collected by C. M. Woodford, Esq. By A. G. Butler, F.L.S., F.Z.S., &c. 240

MISCELLANEOUS.

On the Structure of the Branchia of the Prosobranchiate Gasteropods. By M. Félix Bernard 247

Description of a newly-excluded Young of the *Ornithorhynchus paradoxus*. By Sir Richard Owen, K.C.B., F.R.S., &c. 249

Aulax hypochœridis, a new Gall-fly. By J. J. Kieffer 250

Anatomy and Histology of the Salivary Glands in the Cephalopoda. By M. L. Joubin 251

Habitat of *Peripatus Leuckarti*. By Prof. F. Jeffrey Bell 252

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Vol. 20. FIFTH SERIES. No. 118.

7357
Nov. 8. 1887

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INCLUDING

ZOOLOGY, BOTANY, AND GEOLOGY.

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FIFTH SERIES.]

No. 118. OCTOBER 1887.

XXIX.—*Bryozoa from New South Wales, North Australia, &c.* By Arthur Wm. Waters.

[Plate VII.]

Part III.

Cyclostomata.

When describing fossil Cyclostomata I have had repeatedly to point out how little is known about this suborder, and how few characters there are that can be used in diagnosis. The mode of growth has always been placed in the front rank; but this in other divisions has been clearly shown to have secondary importance, and the same thing may to a certain extent be seen here, for there is *Lichenopora* in both single and confluent colonies and also occurring in many layers. Then, again, *Lichenopora* and *Discotubigera*, as *D. lineata*, are very similar in appearance, but the structural differences indicate that they should be widely separated.

In the Quart. Journ. Geol. Soc. vol. xliii. p. 337, I proposed to divide the Cyclostomata into Parallelata, in which there are no cancelli, and Rectangulata, in which the openings of cancelli occur between the zoœcial tubes. Probably the

Lichenoporidæ and some other families will never be brought into order until the ovicells have been studied in most species, whereas it is astonishing how seldom they have been recorded. This I attribute largely to insufficient search, although often large numbers of specimens may be examined without any ovicells being found; and it is therefore very satisfactory that the present collection enables me to add descriptions of several instances of interesting ovicells. I have also recorded the very interesting discovery of short spines, with knobs, on the outside of the zoarium and ovicells of *Lichenopora grignonensis*, similar to the rays in the inside of the zoœcia. This seems to add to the difficulty of understanding these spines; and we may ask whether the long hair-like spines on *L. ciliata*, *L. echinata*, and *L. pristis* are homologous.

I have referred specially to the family Lichenoporidæ, believing that there is no other which is so likely to throw light on the natural classification and relationship of a large part of the Cyclostomata as this, and the similarity of structure with *Heteropora* &c. makes it possible it may ultimately clear up several obscure palæontological questions*. The size of the lamina upon which it grows does not seem to have any specific value, and the figures now given show how largely the shape of the peristome varies in the same specimen. Other characters have not been sufficiently studied for us to know how far they are variable.

75. *Crisia eburnea* (L.).

For synonyms see Hincks, Brit. Mar. Pol. p. 420, pl. lvi. figs. 5, 6; Pergens, Plioc. Bry. v. Rhodos, p. 3; and Woods, Trans. Roy. Soc. Vict. 1865, vi. p. 5, pl. i. fig. 12.

A small fragment from Shark Island, Port Jackson, 8 fath., certainly seems to be this species; but a determination where there are no ovicells is never very satisfactory.

76. *Crisia Edwardsiana*, d'Orb.

Crisia Edwardsiana, d'Orb. Voyage dans l'Amér. Mérid. p. 7, pl. i. figs. 4–8; (?) Busk, Cat. Mar. Pol. pt. iii. p. 5, pl. ii. figs. 5–8; MacGillivray, Zool. Vict. dec. iv. p. 37, pl. xxxix. fig. 1.

The fragment from La Pérouse is small, but there is no doubt that it is this species. The joints of the internodes and of the spines are black. This piece has no ovicells; but

* I shall be much obliged to Australian or other authors who can let me have authentic specimens of described species in various stages of development.

a specimen from New Zealand has the opening of the ovicell low down on the dorsal surface.

Loc. Patagonia; Tierra del Fuego (?); New Zealand; Victoria; La Pérouse; Botany Bay, New South Wales, washed on shore.

77. *Idmonea radians* (Lamk.), non Defr. (Pl. VI. figs. 27, 28.)

Retepora radians, Lamk. Anim. sans Vert. ii. p. 183.
Idmonea radians, M.-Edw. Ann. Sc. Nat. 2nd ser. vol. ix. p. 217, pl. xii. fig. 4; Stoliczka, Foss. Bry. der Orakei Bay, p. 116, pl. xviii. figs. 9, 10; Busk, Cat. Mar. Pol. pt. iii. p. 11, pl. vii. figs. 1–4; Waters, Quart. Journ. Geol. Soc. vol. xl. p. 684; MacG. Zool. Vict. dec. vii. p. 30, pl. lxviii. fig. 3; Haswell, Proc. Linn. Soc. New South Wales, vol. iv. p. 351; Busk, 'Challenger' Report, pt. ii. p. 10.

I have already (*loc. cit.* p. 676) referred to a structure of the ovicell which seems to have been overlooked by other writers, and now give a figure showing the finely perforated lateral plates. The ovicells are elongated raised protuberances, occurring at a bifurcation, divided up by irregular ridges, between which are large pores deeply pitted, and on each side there are usually two, but sometimes one or three, plates, distinctly bordered and with numerous extremely fine perforations.

The ovicells of the Cyclostomata have nearly always the surface covered with much more numerous pores than the rest of the zoarium; and it is therefore most interesting, and no doubt a fact of considerable physiological importance, that in some cases it is only a part of the ovicell which is provided with these numerous pores.

Loc. Fossil: Mount Gambier (?); Orakei Bay. Living: New Zealand; Tongatabu, 18 fath.; Honolulu, 20–40 fath.; Victoria; Port Jackson (*H.*); Adelaide (*A. W.*); Vaucluse Point; Port Stephens, 5–6 fath.; Green Point, 8 fath., New South Wales, and Darnley Island, Torres Straits, 10–30 fath. (all dredged by *Brazier*).

78. *Idmonea* (?) *irregularis*, Meneghini (non Beissel).

Idmonea irregularis, Menegh. "Polipi della fam. dei Tubul.," Accad. di Sc. di Padova, vol. vi. 1844, p. 12; Waters, Ann. & Mag. Nat. Hist. ser. 5, vol. iii. p. 270; Busk, Chall. Rep. p. 14; Haswell, Heller.
Tervia Folini, Jullien, "Dragages du Travailleur," Bull. Soc. Zool. de France, t. vii. p. 5, pl. xiii. figs. 8, 9.

Specimens from Holborn Island have the oral aperture 0·1 millim. wide. I do not consider that this can remain under *Idmonea*, seeing that the ovicell is dorsal, occurring near a

dichotomization (see Quart. Journ. Geol. Soc. vol. xl. p. 687). In shape it resembles the ovicell of *Crisia* (say *Crisia Houldsworthii*, B., Chall. Rep. pl. iii. fig. 2), but as yet I have only seen it upon the Mediterranean specimens.

Loc. Naples; Adriatic; Tortugas; Bay of Biscay, 2651 metres; Holborn Island (*Hasw. & W.*); Azores, 450 fath. Fossil: Testa del Prado, Calabria (*W.*); and Zanclian, Astian, Sicilian, and Saharian (*Seguenza*).

79. *Idmonea Milneana*, d'Orb.

For synonyms see Waters, Quart. Journ. Geol. Soc. vol. xl. p. 684, and add Busk, 'Challenger' Rep. p. 13.

Tubulipora Dawsoni, Hincks, Ann. & Mag. Nat. Hist. ser. 5, vol. xiii. p. 34, pl. ix. fig. 5.

The branches of a specimen from Green Point anastomose, forming a colony an inch and a half across, and it differs in the branching from *I. interjuncta*, where tubular connexions are thrown across from one branch to another, also the radicles growing from the back of the branches of *I. Milneana* are stouter, being formed of a fasciculus of tubes. The ovicell and the ovicellular opening of this and *I. interjuncta* seem identical (see figure 29 on Pl. VI.), the ovicell being very slightly raised, spreading among a considerable number of zoœcia; the opening is wide, with a raised compressed funnel. Aperture of zoœcial tube 0·2 millim. wide.

Mr. Busk, in his 'Challenger' Report, says "ovicell unknown;" but this I have previously described from Capri. I have reexamined the British-Museum specimens of *I. notomale*, B., and have no doubt of this being only a synonym; in fact the Museum specimens of the latter and *I. Milneana* are so similar that they might well be fragments of the same colony.

Loc. Living: Falkland Islands (*d'Orb.*); Patagonia, 30 fath.; Chonos Archipelago; Florida; S.W. Chili, 0–30 fath.; Capri; New Zealand (*A. W. W.*); Heard Island, 75 fath.; Prince Edward Island, 80–150 fath.; Fiji Islands, 450 fath.; Queensland; Victoria; Green Point, Port Jackson, 8 fath. Fossil: Latdorf (Oligocene); Orakei Bay, New Zealand; Mount Gambier, Curdie's Creek, Bairnsdale (Australia).

80. *Idmonea interjuncta*, MacG.
(Pl. VI. fig. 29.)

Idmonea interjuncta, MacG. Descrip. of New or Little-known Polyzoa, pt. ix. (1885), Trans. Roy. Soc. Vict. p. 10 (sep.).

? *Idmonea Pedleyi*, Haswell, "Cyclost. Polyzoa of Port Jackson," Proc. Linn. Soc. N. S. Wales, vol. iv. p. 351.

Specimens from Green Point correspond entirely with MacGillivray's description; but I believe that Haswell's name, which has priority, ought to be adopted, though as long as there is any uncertainty it is better to adhere to *interjuncta*.

It forms a subglobular intricate mass nearly two inches across, made up of slender branches, which dichotomize and are attached to one another by delicate tubes thrown across from neighbouring branches: similar tubes are often thrown out as long delicate rootlets; these tubes are usually single, but sometimes in bundles. The zoœcia are smaller than those of *I. Milneana*, the aperture only measuring 0·14 millim., and the dorsal striation is more distinct in these specimens than in *I. Milneana* from the same locality. The ovicell, as shown in the figure, is an inflation occurring usually at the junction of the branches, and embraces many zoœcia; the surface of the ovicell is more finely punctured than that of the zoœcia, and the aperture is wide, with a raised funnel-shaped peristome.

It will be seen in figure 29 that the middle connecting-tube passes from the right-hand branch to the left, whereas the other two arise from the left- and are attached to the right-hand branch.

Kirchenpauer describes (Mus. Godeffroy Cat. iv. p. xxxiii) similar connexions in *Idmonea flabellata*, from the Gulf of St. Vincent.

Loc. Port Phillip Heads (*MacG.*); Green Point, Port Jackson, 8 fath.

81. *Filisparsa tubulosa* (Busk).

Hornera violacea, var. β. *tubulosa*, Busk, Cat. Mar. Pol. pt. iii. p. 19, pl. xviii. fig. 4.

Filisparsa tubulosa, Waters, Ann. & Mag. Nat. Hist. ser. 5, vol. iii. p. 275.

Filisparsa Delvauxi, Pergens, "Pliocene Bry. von Rhodos," Ann. k.-k. Hofmus. vol. ii. p. 6.

Idmonea gasparensis, MacG. "New or Little-known Polyzoa," pt. xii., Trans. Roy. Soc. Vict. p. 7 (sep.), pl. ii. fig. 3.

Filisparsa, sp., Manzoni, Mém. de la Soc. Géol. de France, 3ᵉ sér. vol. i. pt. ii. p. 69, pl. iii. figs. 18 *a* and 18 *b*.

There is one piece from Holborn Island, 20 fath., which is more delicate than *I. irregularis* and has fewer zoœcia. The oral aperture is 0·15 millim. wide. There is no ovicell, but my specimens from Naples have ovicellular enlargements embracing several zoœcia near a new branch on the front surface. The numbering of Busk's figures in his description and his explanation of the plates does not correspond, and it is very difficult to know what was meant.

A fossil, which I described as *F. orakeiensis*, Stol. (Quart. Journ. Geol. Soc. vol. xl. p. 687), from Mount Gambier, with oral aperture about half the size, has the ovicell on the dorsal surface, in this respect corresponding with *I. irregularis*, Menegh., and from this it will be seen that there is considerable uncertainty in the determination when the ovicell is not preserved.

It would seem that *I. irregularis* and *F. orakeiensis* should be removed to another genus on account of the position of the ovicell. There is also *Hornera tubulosa*, Meneghini, which may be this species.

Loc. Naples (*W.*); Victoria (*MacG.*); Holborn Island, Queensland, 20 fath. Fossil: Rhodes.

82. *Tubulipora fimbria*, Lamk.

There are two small pieces from Bondi Bay, Sydney, which do not seem to differ in size of the zœcial tubes or the arrangement of the zoœcia from the European species; but from small pieces the specific determination is doubtful. The ovicells are inflations near the end, with wide funnel-shaped openings.

83. *Tubulipora fimbria*, Lamk., forma *pulchra*, MacG. (Pl. VII. figs. 1, 2, 3.)

Type *Tubulipora fimbria*, Lamk. Hist. Anim. sans Vert. ed. 1, vol. ii. p. 163; and for synonyms see Hincks, Brit. Mar. Polyz. p. 448, pl. lx. fig. 3, and Busk, 'Challenger' Rep. p. 23, pl. v. fig. 2.
Tubulipora pulchra, MacGillivray, Trans. Roy. Soc. Vict. vol. xxi. p. 95, pl. ii. fig. 1.

There are a large number of specimens from Vaucluse Point, which have grown upon seaweed and have a very interesting attachment. The primitive disk has small dentate projections all round, and besides these there are all over the dorsal surface broad tubular teeth at short intervals, arranged in curved lines following the outlines of the zoœcia. Mr. Busk, in "Zool. of Kerguelen Island," Trans. Roy. Soc. vol. clxviii. p. 19, pl. x. figs. 20–25, records a similar denticulate border of the primary disk of what he considers *T. organizans*, d'Orb., but does not mention any other attachment. *Idmonea serpens* also throws out dentate processes from the side of the zoarium, but they can scarcely be compared with those now described.

The zoarium is flabelliform, with sometimes two or three lobes; but none of the specimens are large or are much divided. The aperture of the zoœcia is only 0·07–0·08 millim.

wide inside and about 0·1 millim. outside, which is not much more than half the size of that of European *T. fimbria*, and the ends are slightly contracted, but not anything like so much as in MacGillivray's figure of *T. pulchra*; in fact, without careful examination the contraction would be overlooked. The ovicells are inflations near the border embracing many zoœcia, and with wide, irregular, funnel-shaped openings.

The zoœcial tubes are punctured, except at the ends, where there are few or no punctures. With *T. flabellaris* and *T. fimbria* there has been some confusion, which is not lessened by strictly following zoological rules. Johnston, Busk, Hincks, &c. had called what we now consider *T. fimbria T. flabellaris*; but Smitt showed that this was wrong, and that *T. flabellaris* of Fabricius was what Couch, Busk, Hincks, Waters, &c. had called *T. phalangea*; so that both species have in well-known works been called *flabellaris*, and when, as in the present instance, MacGillivray refers to *T. flabellaris* it is impossible to know which species is meant.

Typical *T. fimbria* occurs abundantly in European and northern seas, and is recorded from a few localities in the southern hemisphere. *T. pulchra* is found in Victoria, but MacGillivray does not say where. Vaucluse Point, Port Jackson, 5 fath. (dredged by *Brazier*).

84. *Entalophora fragilis* (Hasw.).

Pustulipora fragilis, Haswell, "Polyzoa from the Queensland Coast," Proc. Linn. Soc. New South Wales, vol. v. p. 35.

There are numerous fragments from Darnley Island of a very delicate *Entalophora*, with the zoarium about 0·5 millim. in diameter, with few zoœcia, separated by wide intervals.

I do not find any black-pointed spinules; but this may arise from the state of preservation, or it may be a varietal character. The aperture of the zoœcium is about 0·1 millim.

Loc. Holborn Island, Queensland (*H.*); Darnley Island, Torres Straits, 10–30 fath.; and Princess Charlotte Bay, N.E. Australia, 13 fath.

85. *Fasciculipora bellis*, MacG.

Fasciculipora bellis, MacGillivray, Trans. Roy. Soc. Vict. vol. xx. p. 127, pl. i. fig. 2.

From the Bottle-and-Glass Rocks there is a specimen with more than thirty erect fasciculi. Each fasciculus rises from a concentric calcareous crust, which is punctured with rather large pores; and these basal crusts usually become confluent, and sometimes have a few zoœcial openings, and also on the

sides of the fasciculi there are zoœcial apertures, so that in places it looks like a little forest of *Entalophora.*

It is a question whether this is a complete growth, or only the young form of a growth like *Fascicularia tubipora*, and from one piece this cannot be decided.

Loc. Port Phillip Heads; Bottle-and-Glass Rocks, Port Jackson, 8 fath., "rocky bottom" (*Br.*).

86. *Mesenteripora repens*, Haswell.
(Pl. VII. figs. 6 & 7.)

Mesenteripora repens, Haswell, Proc. Linn. Soc. N. S. Wales, vol. vi. p. 199.

Some specimens from Watson's Bay spread over *Cellepora* &c., forming layers several inches across. On the basal portion the zoœcial divisions are scarcely visible, and the zoœcial tubes are mostly closed by a cover with a projecting tubule, but near to the raised ridges the zoœcia project and are more or less free; and from the ridges themselves they project a considerable distance, with a bilabiate peristome. I have also a specimen of *Mesenteripora* from Port Phillip in which the zoœcia on the basal crust are distinct and free at the end, with covers having an excentric projecting tubule, and the zoœcia are not formed into long elevated ridges, but rise up about 3–4 millim. as small compressed stalks with a lamina in the middle along the longer axis.

Mesenteripora repens, with its beautiful white punctured surface, is a very attractive object.

Loc. Broughton Island, New South Wales (*H.*); Watson's Bay, Port Jackson, "under stone" (sent by *Brazier*).

87. *Discotubigera* (?) *lineata* (MacG.).
(Pl. VI. fig. 24.)

Diastopora lineata, MacGillivray, Trans. Roy. Soc. Vict. vol. xxi. p. 96, pl. iii. fig. 1.

Liripora lineata, MacG. Cat. Mar. Polyzoa of Vict., Roy. Soc. Vict. 1887, p. 32.

All my specimens are surrounded by a broad lamina, and the central cells are closed by a perforated membrane; the series of zoœcia are very much raised near the border. In two specimens the zoarium is regularly discoid, about 5 millim. in diameter—one from Port Phillip spreads irregularly over a space of about $\frac{3}{4}$ inch, forming strap-shaped lobes. The ovicells occur as tangential swellings near the border, and have a round tubular opening at the base.

The zoarial appearance is much the same as that of *Lichenopora*, but there are no interstitial pores, and the structure is

of course quite different; but so long as we are in a tentative stage with the Cyclostomata I do not see that a form in which the zoœcia are gathered so distinctly into rays or ridges can at present be united with *Diastopora*.

This is no doubt nearly allied to the fossil from Aldinga which I described as *Discotubigera clypeata*, Lamx. (Quart. Journ. Geol. Soc. vol. xl. p. 690, pl. xxxi. figs. 15, 16, 19).

Loc. Port Phillip and Port Phillip Heads; Double Bay, Port Jackson, "under stones."

88. *Lichenopora novæ-zelandiæ* (Busk). (Pl. VII. fig. 8.)

Discoporella novæ-zelandiæ, Busk, Cat. Mar. Pol. pt. iii. p. 32, pl. xxx. fig. 2; Haswell, Cyclost. Polyzoa from Port Jackson, Proc. Linn. Soc. New South Wales, vol. iv. p. 353.

The description of Busk leaves it somewhat uncertain as to whether this is the species intended, and where the ovicell is undescribed this will often be the case.

Where there is no ovicell the zoœcial tubes run into the centre, the central depression forming an inverted cone without cancelli; in this respect these specimens differ from Mr. Busk's figure. The outer cancelli are formed of bars from the radii, and there is usually only one row of cancelli between the radii. The inner side of the peristome is the longer, sometimes the outer zoœcia have the peristome wide and acuminate in the centre. The ovicell is considerably raised and occupies the whole of the centre; the central portion is flat and is bounded by a raised meandering ridge, from which the sides slope steeply down. The aperture of the ovicell is near one end of the flat space and is semicircular. On the lower left-hand side of the specimen figured there is a tube which I do not understand, but probably it is a zoœcial tube irregularly placed. Zoœcial aperture about 0·07 millim. in diameter.

Loc. New Zealand (*B.*); Port Jackson (*Haswell*); Bondi Bay, near Sydney, New South Wales.

89. *Lichenopora Houldsworthii* (Busk).

Discoporella Houldsworthii, Busk, Cat. Mar. Pol. pt. iii. p. 33, pl. xxx. fig. 4.

Lichenopora Houldsworthii, Waters, Quart. Journ. Geol. Soc. vol. xliii. p. 347.

There is a specimen from Watson's Bay with the cancelli about 0·07 millim. and the zoœcial apertures nearly as large. In the interior of both zoœcial tubes and cancelli there are numerous radiating spines with a nodular termination, the

exact shape of which I have not had the opportunity of making out.

Loc. Living: Ceylon (*B.*); Port Phillip Heads (*MacG.*), Port Western, Victoria; north side of Watson's Bay, "under stones," Port Jackson. Fossil: Waipukurau, New Zealand.

90. *Lichenopora grignonensis* (Busk). (Pl. VII. fig. 4.)

Discoporella crassiuscula, Smitt, Œfver. K. Vetens.-Ak. Förh. vol. xxiii. pp. 406 and 482, pl. xi. figs. 7–9.
Discoporella grignonensis, Busk, Crag Polyzoa, p. 116, pl. xx. fig. 4.
Lichenopora grignonensis, Ridley, Zool. Coll. of H.M.S. 'Alert,' Proc. Zool. Soc. 1881, p. 57, pl. vi. fig. 2.
Lichenopora canaliculata ?, Busk, Phil. Trans. vol. 168 (ex.), p. 199, pl. x. figs. 12–14.

I have figured a specimen from Vaucluse Point, showing the great variation in shape of the zoœcial orifices, which near the periphery have usually projections at the two sides, forming what Ridley calls a sinus, in the central zoœcia, and have the inner side much raised, but also divided by a sinus; the outer side is also raised often into a pointed process. Zoœcial opening about 0·08 millim. The central zoœcia are much raised, and when there is no ovicell nearly meet in the depressed centre of the zoarium. The ovicell covers the central area and is formed by a network of trabeculæ, the interspaces of which are closed by a calcareous perforated crust. The sides of the zoœcia have nodulated ridges, the nodules sometimes becoming bluntly spinous.

In the interior of the zoœcia there are radiating spines with knobs at the end, but also on the outside of the zoœcia there are similar spines projecting from the trabeculæ. This is the first time, so far as I am aware, that these spines have been recorded from the outside of the zoarium, which seems to make it more difficult to understand what their function can be.

I have a specimen from the Semaphore, Adelaide, in which the nodulated ridges are much more distinct and the inner part of the peristome is much raised, whereas the portion turned towards the periphery of the zoarium is deeply cut away; another specimen from the same locality has the nodulated ridges also well marked, but the peristome is nearly round and entire, as figured by Busk in his *L. canaliculata*.

I cannot see that there is sufficient ground for identifying Busk's species with that of Milne-Edwards, and think that *L. canaliculata*, Busk, is probably the same as the Crag fossil; but since the shape of the aperture is figured as being

different I hesitate either to unite them or to give a new name, and therefore follow Ridley in regarding this as Busk's species, since I am not certain that *L. crassiuscula*, Smitt, is identical, whereas there is no doubt that this is the species described by Ridley.

In the figures of both this and *L. ciliata* I have not shown the convex shape of the zoarium, in order that the variations in the peristome might be clearly seen.

Loc. Living: Sandy Point (*R.*); off Vaucluse Point, Port Jackson, 5 fath., and Bondi Bay, New South Wales; Bahusia (?) (*Sm.*). Fossil: Crag (?).

91. *Lichenopora ciliata* (Busk). (Pl. VII. fig. 5.)

Discoporella ciliata, Busk, Cat. Mar. Pol. pt. iii. p. 31, pl. xxx. fig. 6, and pl. xxxiii. fig. 4; Haswell, Cyclost. Polyzoa from Port Jackson, p. 354.

In a specimen from Port Stephens the zoœcia are irregularly arranged, or in parts indistinctly radial, and the inner edge is prolonged, usually with a deep notch in front, forming an apparent sinus; sometimes the peristome is divided into several processes, and in some cases the zoœcial tubes can be seen to be slightly ridged. Zoœcial aperture about 0·07 millim. diameter. There are numerous long hair-like spines growing from all parts of the zoœcial tube and some from the central cancelli. The ovicell spreads among a number of zoœcial tubes and opens with a long inflated tube directed towards the centre of the zoarium.

It will be seen that this approaches very closely to *L. grignonensis*, and that it differs from *L. echinata*, MacG., in not having rounded central cancelli, from *L. complicata*, Haswell, in not having the peristome round and entire, and from *L. reticulata*, MacG., in not having the peristome produced on the inner border but on the outer. I have a specimen from Port Phillip which agrees with this in having the central portion reticulated, and has similarly numerous long spines; another one from the same locality is similar in regard to the arrangement of the zoœcia, the shape of the zoœcial tubes, and the peristome; but the large rounded central cancelli are closed with a perforated pellicle, and above this there is the commencement of a thin, calcareous, perforated, plain crust, which is, no doubt, the commencement of an ovicell. There are in this last specimen a few long spines from the cancelli, but none from the surface of the zoœcial tubes.

Ought not *L. ciliata* to be considered a variety of *L. verrucaria*, Fab.?

Loc. Cape of Good Hope; New Zealand (*B.*); Port Stephens, New South Wales (sent by *Brazier*).

Ctenostomata.

92. *Amathia semispiralis*? (Kirchenpauer).

Serialaria semispiralis, Kirch. Cat. Mus. Godeffroy, iv. p. xxxiv.
Amathia semispiralis, Busk, Chall. Rep. p. 36, pl. viii. fig. 3.

There is a small dried fragment of *Amathia* from Darnley Island, Torres Straits, in which the zoœcia are arranged spirally, but are broken up into groups, and in our present state of knowledge we may doubt whether this should be separated from *A. semiconvoluta*.

There is also an *Amathia* found in Naples which has the zoœcia arranged spirally, but only has zoœcia in the upper half of the internode. This Kirchenpauer called in manuscript *A. distans*—a name since given by Busk to another species.

93. *Amathia biseriata*, Krauss. (Pl. VI. fig. 25.)

Amathia biseriata, Krauss, Corallineen und Zoophyten der Südsee, 1837, p. 23, fig. 1.
Serialaria Woodsii, Goldstein, Quart. Journ. Micr. Soc. Vict. vol. i. no. 1, p. 20, pl. iii. fig. 5.

This species is attached by thick bundles of radical tubes, as described and figured by Krauss, but my specimens have not such a mass of root as he shows. The number of zoœcia is not constant, about eight pairs is the most usual, but I have counted thirteen pairs, and the zoœcia usually occupy about four fifths of an internode, though sometimes almost the entire internode is filled up.

Tenison Woods in his list of works on *Amathia* does not mention Krauss, so that probably both he and Goldstein were unacquainted with his work.

This is allied to *A. lendigera*, L., but differs in having shorter internodes more closely filled up. The earlier writers all seem to have described and figured *A. lendigera* as having only a single series of zoœcia; but Hincks, Busk, &c. now speak of its having a double series, and European specimens in my collection have two series.

I have *A. lendigera* from Cape Agulhas, South Africa.

In *A biseriata* a radicle is often thrown out from the under surface of the branches (see fig. 25).

Loc. Australia (*K.*); Portland, Victoria (*G.*); mouth of Lane Cove River, 7 fath., N. S. Wales, and Shark Island, 8 fath.

Since the previous part was written I have found a fragment of *Membranipora cervicornis*, B., from Shark Island, 8 fath., and I also overlooked Kirchenpauer's paper in the Proc. Linn. Soc. New South Wales, vol. ix. 1884, in which mention is made of *Catenicella ventricosa*, *C. Buskii*, *Cellularia cuspidata*, *Menipea crystallina*, from the coast near Mount Dromedary, and of *Didymia simplex* and *Bugula dentata* near the entrance of the Richmond River.

Besides the seventy-nine species now recorded from New South Wales there are forty-three more described by Kirchenpauer, Busk ('Challenger' Report), and Haswell; but there are still many species that are common in the other colonies and neighbouring seas which have not yet been recorded from New South Wales, though probably, when anyone, following MacGillivray's example, studies the Bryozoa as carefully and systematically as he has done in Victoria, the two colonies will be found to have an equally rich fauna.

EXPLANATION OF PLATE VII.

Fig. 1. *Tubulipora fimbria*, Lamk., var. *pulchra*, MacG., ×25.
Fig. 2. *Tubulipora fimbria*, Lamk., var. *pulchra*, ×85, showing central zoœcia and dorsal attachments.
Fig. 3. *Tubulipora fimbria*, Lamk., var. *pulchra*, ×25, showing dorsal attachments of colony.
Fig. 4. *Lichenopora grignonensis* (Busk), × 25, from Vaucluse Point.
Fig. 5. *Lichenopora ciliata* (Busk), ×25, from Port Stephens.
Fig. 6. *Mesenteripora repens*, Haswell, ×16.
Fig. 7. *Mesenteripora repens*, Haswell, natural size.
Fig. 8. *Lichenopora novæ-zelandiæ* (Busk), ×25, from Bondi Bay.

XXX.—*Descriptions of eight new Species of Asiatic Butterflies.* By H. Grose Smith.

Appias Lalassis.

Male.—Upperside. Both wings white. Anterior wings falcate, with a small black spot at the end of the cell, the apex and outer margin as far as the second median nervule irrorated with black.

Underside. Anterior wings white, the spot at the end of the cell larger than on the upperside; a spot between the lower discoidal and first median nervules; apex pale pinkish brown. Posterior wings pale pinkish brown, shaded with indistinct brown markings.

Female.—Upperside with the apex of the anterior wings

blacker than in the male and a grey spot between the lower discoidal and first median nervules.

Expanse of wings $2\frac{3}{4}$ inches.

Hab. Burmah, near the Siamese frontier (*Capt. Adamson*).

In the collection of Mr. Adamson.

Near to *Lalage*, but anterior wings more falcate and apex much less black; the spot at the end of the cell smaller and underside paler.

Delias agoranis.

Male.—Upperside. Anterior wings white, with the apical third grey, in the centre of which is a curved band of greyish-white spots, the lowest at the inner angle being on the margin; the veins and costa grey. Posterior wings creamy white, with the colour and border on the underside showing through; three large, triangular, grey, marginal spots at the tips of the second and third median nervules and of the submedian nervure.

Underside. Anterior wings as above, but darker; a large dark grey spot at the end of the cell; extending broadly along the second discoidal nervule, between the outer band of grey spots and the cell are four oblong white spots, the first and third being the largest. Posterior wings bright yellow, broadly bordered with dark grey; in the middle of the border is a row of oval white spots, the uppermost tinted with yellow; on the inner side of the border the grey extends partially up the nervures.

Expanse of wings $3\frac{7}{8}$ inches.

Hab. Burmah, Siamese frontier (*Capt. Adamson*).

In the collection of Mr. Adamson.

Near to *D. agostina* and *D. Kuhni* of Honrath; but a larger and more brightly coloured butterfly than the former.

Paduca flavobrunnea.

Upperside. Both wings yellowish brown, crossed with a broad, paler yellowish-brown band. Anterior wings: in the band are two rows of brown hastate markings, the inner row nearly obsolete, except near the inner margin, the outer row, especially towards the costa, darker and more distinct; a dark brown band on the outer margin, in which is a row of pale yellowish-brown spots; on the posterior wings the band is traversed by a row of six dark brown spots, the third almost obsolete; above the spots is a fulvous streak, and another below; a dark brown band on the margin centred as in the upper wing.

Underside. Both wings pale brown, showing indistinctly

the markings on the upperside; but the row of spots on the posterior wing is well defined, except the third, which is obsolete.

Expanse of wings $1\frac{3}{4}$ inch.

Hab. Burmah, Siamese frontier (*Capt. Adamson*).

In the collection of Mr. Adamson.

Paduca myrsa.

Upperside. Both wings cinereous, tinged in certain lights with pink, crossed in the middle by a pinkish, dusky white band from near the costa of the anterior wing, where it tapers, to the anal angle; beyond the band is an indistinct submarginal light ashy brown line, outside of which is an indistinct band of darker brown spots.

Underside as above, but lighter, with the bands, lines, and spots more clearly defined.

Expanse of wings 2 inches.

Hab. Celebes.

In the collection of H. Grose Smith.

This should probably be placed in a new genus.

Yphthima savara.

Upperside. Both wings ashy brown. Anterior wings with one large subapical ocellus with a central spot, and one minute spot above it, the space round the ocellus lighter than the rest of the wing. Posterior wings with two small submarginal ocelli near the costa and two large subanal ocelli, the ocelli being situated in a space or band of lighter brown than the rest of the wing.

Underside. Paler than above. Anterior wings with two dark brown central lines and one submarginal line. Posterior wings with the ocelli represented as above, but small and of a uniform size, and two small anal ocelli; two brown lines across the centre of the wings.

Expanse of wings $2\frac{1}{4}$ inches.

Hab. Burmah, Siamese frontier (*Capt. Adamson*).

In the collection of Mr. Adamson.

This is the largest species of this genus I have seen.

Messaras dapatana.

Upperside. Anterior wings brown, paler towards the base, crossed by a transverse broad band (the inner edge of which is deeply indentated in the middle) of pale creamy brown from the centre of the costa to near the inner angle. Halfway between the exterior margin and the cell is a row of brown spots, indistinct except when the row crosses the transverse band and the lowest spot near the inner angle. Poste-

rior wings same colour as the base of anterior wings; at the middle are two narrow sinuate lines, the space between which is light brown followed by a row of dark brown spots, then a row of lunular contiguous spots, a submarginal brown line, and another on the margin.

Underside. Paler and brighter than on the upperside, the row of dark brown spots on both wings much more distinct, the row on the posterior wings being surrounded with bright brown, inside which is a whitish sinuate band, slightly opalescent.

Expanse of wings $3\frac{1}{8}$ inches.

Hab. Dapatan, one of the Philippine Islands.

In the collection of H. Grose Smith.

Near to *Erymanthis*, but abundantly distinct.

Amblypodia arracana.

Upperside. Purple. Exterior margin of both wings broadly dark brown; posterior wings with a large reddish-brown lobe at the anal angle.

Underside. Rufous, crossed from near the apex of the anterior to centre of the inner margin of the posterior wings by a brown-black line, between which and the base the space is more or less densely irrorated with the same colour. Halfway between the line and the outer margin of both wings is a brown-black band of minute maculæ, and another on the lower part of the outer margin of the posterior wings.

Expanse of wings 2 inches.

Hab. Arracan Hills (*Capt. Adamson*).

In the collection of Mr. Adamson.

Near to *A. anata*, but a larger and brighter insect.

Amblypodia tounguva.

Male.—Upperside. Brilliant blue, the apex, costa from near the base, and exterior margin of anterior wings, and the exterior margin of posterior wings broadly brown-black.

Underside. Pinkish brown, slightly suffused with purple. Anterior wings with two spots in the cell and one beyond the cell, followed by a broad straight band of contiguous spots, the spots all being brown bordered with lighter pinkish brown, a broad brown patch below and beyond the cell and exteriorly almost to the base, beneath which the space to the inner margin is pale brown. Posterior wings with numerous brown spots bordered with light pinkish brown.

Female.—Upperside. Paler and margins less broadly black.

Expanse of wings $1\frac{1}{2}$ inch.

Hab. Toungu, Burmah.

In the collection of H. Grose Smith.

XXXI.—*Description of a new Rat from North Borneo.*

By Oldfield Thomas.

Among the small Mammals obtained by Mr. John Whitehead during his expedition to Mount Kina-Balu is a skin of a very handsome long-tailed rat belonging to the group of mountain-rats that contains *Mus Jerdoni*, Bl., *M. Edwardsi*, Thos., *M. coxinga*, Swinh., *M. Blanfordi*, Thos., *M. Hellwaldi*, Jent., and others, but representing a new and very distinct species. I propose to call it

Mus sabanus *, sp. n.

Fur short and fine, mixed with slender spines along the centre of the back. General colour rufous, mixed with brown along the top of the head and back, brighter and clearer on the cheeks and sides, the general tone very similar to that of *M. Jerdoni*. Whole of underside pure creamy white, sharply defined from the rufous of the sides. Outsides of limbs like sides, but rather greyer, inner sides white; lower leg and ankles greyish brown all round. Hands and feet brown along the middle of their upper surfaces, their edges white, the contrast especially strongly marked on the feet, where a broad band of deep blackish brown passes along the centre, edged on each side with pure white. Sole-pads large, smooth and prominent, the last one about three times as long as broad. Fifth hind toe, without claw, reaching to the end of the first phalanx of the fourth. Ears rounded, rather short, laid forward they do not reach to the eyes. Tail enormously long, evenly finely haired, the scales, which are large, averaging from seven to nine to the centimetre, uniformly dark brown or black above and below throughout, but the hairs black for the proximal two thirds above only, elsewhere pure white.

Dimensions of the type, an adult male, preserved as a skin:—

Head and body 280 millim.; tail 340; hind foot 43·5; ear, above head 18, breadth 18; heel to front of last foot-pad 23; length of last foot-pad 7·0.

Skull: tip of nasals to centre of fronto-parietal suture 36 millim.; nasals, length 21, greatest breadth 6·0; interorbital breadth 7·7; anterior zygoma-root, length 4·7; palate, length

* From Saba, the district of North Borneo in which Mount Kina-Balu stands.

26·5; palatal foramen, length 7·9; back of incisors to molars 13·6; length of molar series 9·4.

The typical specimen, as well as the two new squirrels described in the August number of the 'Annals,' was obtained at an altitude of more than 3000 feet, Mr. Whitehead not commencing to collect until he had passed this height.

Mus sabanus may be readily distinguished from any of the species above mentioned by its enormously long tail, the peculiar coloration of its hands and feet, and by its size, *M. Edwardsi* alone being very materially larger, and all the others considerably smaller.

One species, however, also a native of Borneo, has a superficial resemblance to *M. sabanus*, although belonging to quite a different group of rats. This is *M. Mülleri*, Jent., of about the same size and with a nearly equally long tail, but which may be distinguished by its coarse *M. decumanus*-like fur, yellowish instead of rufous coloration, the less sharply-defined white underside, and by the quite uniformly brown-haired feet and tail.

XXXII.—*Notes on* Sphingidæ *from the Malay Peninsula, and Description of a new Species of* Ambulyx *from North Borneo.* By W. L. Distant.

During the time I was collecting and receiving butterflies from the Malay Peninsula as material for a recent publication a considerable number of Heterocera were also accumulated, which it is now proposed to work out. Of the family Sphingidæ I have received the following sixteen species; three more have been described by Mr. Butler, and another two recorded from Malacca by Mr. Walker. This brings the list of Sphingidæ found in the Malay Peninsula to twenty-one species, though doubtless many more remain to be discovered.

In my own Collection.

Macroglossa proxima, *Butl.*
Pergesa acteus, *Cram.*
Panacra vigil, *Guér.*
Chœrocampa alecto, *Linn.*
—— celerio, *Linn.*
—— silhetensis, *Walk.*
—— Lucasii, *Walk.*
—— punctivenata, *Butl.*
Chœrocampa nessus, *Dru.*
—— erotus, *Cram.*
Philampelus helops, *Walk.*
Acherontia medusa, *Butl.*
—— lachesis, *Fabr.*
Protoparce orientalis, *Butl.*
Pseudosphinx nyctiphanes, *Walk.*
Diludia discistriga, *Walk.*

Described and Figured from Malacca.

Macroglossa obscuriceps, *Butl.*
Lophura minima, *Butl.*
Mimas terranea, *Butl.*

Recorded from Malacca by Mr. Walker.

Macroglossa passalus, *Dru.*
—— corythus, *Boisd.*

Thanks to the exertions of Mr. Pryer I have been able to acquire some knowledge of the moths of Northern Borneo, and find, as with the butterflies, that the Malay and North-Bornean species are in very many cases identical. The following North-Bornean species, which is here described, may be sought for in the Malay Peninsula with every probability of success, as most of the Sphingidæ appear to be common to the two regions.

Ambulyx Pryeri, n. sp.

Anterior wings above pale reddish brown, the venation distinctly darker; a dark submarginal line reaching from apex to outer angle; a large, dark, rounded spot near base beneath the submedian nervure, and five very obscure olivaceous-brown spots on costal area, situate two above cell, the outermost continued to lower apical angle of cell by a waved line, and three linear between end of cell and apex of wing. Posterior wings warm ochraceous, with a large basal patch; a transverse median fascia, attenuated towards the abdominal margin, followed by a narrower waved and somewhat lunate fascia, also attenuated towards abdominal margin; a small subapical spot and another small submarginal spot near lower median nervule dark brownish, the basal markings darkest; between the median fascia and the outer margin the colour is speckled with brownish. Wings beneath ochraceous; anterior wings with the apical half much speckled with brownish, the outer margin violaceous brown; posterior wings with the markings above much fainter and pale reddish brown beneath. Body above pale reddish brown, the thorax with an oblique olivaceous-brown fascia on each side; body beneath and palpi warm ochraceous.

Exp. wings 144 millim.

Hab. North Borneo, Sandakan (*W. B. Pryer*). Coll. Dist.

This species is most closely allied to *A. liturata*, Butl.,

from which it differs by the paler anterior wings and the much larger basal spot to same; on the posterior wing it is also distinguished by the presence of the dark patch at base, and by the outer fascia being more lunate and channelled. The costal markings of the anterior wings are also smaller, whilst *A. Pryeri* is of a larger size and brighter hue than *A. liturata*.

Although no species of *Ambulyx* has yet been received from the Malay Peninsula, it is almost more than probable that several species are to be discovered there. The genus is an extensive one with a wide range, and the following is a geographical list of the species, which, I believe, is fairly complete, though of course subject by future comparison to analytical specific reduction.

Palæarctic Region.

Ambulyx ochracea, *Butl.* (Japan).

Ethiopian Region.

Ambulyx constrigilis, *Walk.*
—— Grandidieri, *Mab.*
Ambulyx Watersii, *Butl.*
—— Coquerelli, *Boisd.*

Oriental Region.

Ambulyx substrigilis, *West.*
—— maculifera, *Walk.*
—— liturata, *Butl.*
—— rhodoptera, *Butl.*
—— subocellata, *Feld.*
—— sericeipennis, *Butl.*
—— lahora, *Butl.*
—— turbata, *Butl.*
—— Moorei, *Butl.*
—— canescens, *Walk.*
Ambulyx rubricosa, *Walk.*
—— floralis, *Butl.*
—— auripennis, *Moore.*
—— junonia, *Butl.*
—— consanguis, *Butl.*
—— Elwesi, *Druce.*
—— argentata, *Druce.*
—— Thwaitesi, *Moore.*
—— Pryeri, *Dist.*

Neotropical Region.

Ambulyx strigilis, *Linn.*
—— eurycles, *H.-S.*
—— tigrina, *Feld.*
—— gannascus, *Stoll.*
—— rostralis, *Boisd.*
—— marginata, *Butl.*
—— eurysthenes, *Feld.*
Ambulyx sexoculata, *Grote.*
—— Guessfeldti, *Dewitz.*
—— Depuiseti, *Oberth.*
—— Palmeri, *Boisd.*
—— crethon, *Boisd.*
—— astygonus, *Boisd.*
—— lycidas, *Boisd.*

One or two other species, either doubtfully belonging to the genus or described without habitat, which is still unknown, are not included in the above.

XXXIII.—*On the Interpretation of* Polyparium ambulans, *Korotneff.* By Prof. E. Ehlers*.

The *Polyparium ambulans* described in a former memoir by Dr. A. Korotneff† is, in my opinion, capable of a different interpretation from that there given to it. It may, indeed, appear a delicate proceeding for me to venture to express an opinion upon a doubtful animal form without having myself seen it, and solely from the investigation of another naturalist; but as I do this with Dr. Korotneff's knowledge, I am urged thereto by the wish to call attention not only to this interesting form of polyp, but also to the occurrence of certain animal forms which, perhaps, possess a community of character.

From the description which Dr. Korotneff has given of *Polyparium ambulans*, and especially of its histological structure, it appears indubitably that from all its peculiarities the animal is to be referred to the Anthozoa. Korotneff expects to obtain elucidations of *Polyparium* from a better knowledge of the genus *Mœandrina*; from his point of view an accurate investigation of the remarkable *Ricordea florida*, Duch. & Mich.‡, would probably contribute still more to a settlement, seeing that *Ricordea florida* stands in the same relation to the Actiniæ generally as the *Mœandrinæ* to the *Caryophylliæ*. Both genera, the skeleton-forming as well as the fleshy one, have it in common that they become developed from simple personæ to stocks with imperfect separation of the numerous personæ.

Here comes in Korotneff's conception of *Polyparium ambulans*, inasmuch as he regards this animal also as an imperfect stock-formation. And here comes my different interpretation, inasmuch as I regard *Polyparium* as only *one* persona.

Mœandrina and *Ricordea* are animals with multiple buccal apertures, but, along with these, with common circlets of tentacles, a phenomenon of which we also know of analogies among the Acalephs; and it is quite justifiable to infer a persona to each buccal aperture in the imperfect stock. It is in this way that Korotneff regards *Polyparium* as a creature with numerous buccal apertures, and, accordingly, as an

* Translated from the 'Zeitschrift für wissenschaftliche Zoologie,' Band xlv. pp. 491–498.

† See 'Annals,' September 1887, p. 203.

‡ Duchassaing et Michelotti, "Mémoire sur les Coralliaires des Antilles," in Mem. Accad. Sci. Torino, ser. ii. tomo xix. (1861), p. 317.

imperfectly differentiated stock. We should adopt his view if we ascribe to this creature the possession of numerous buccal apertures and deny it tentacles. But then the animal remains quite isolated in the circle of its allies, and even as compared with *Mæandrina*.

In my opinion *Polyparium* is a tentaculigerous but astomatous simple animal. This different view rests upon the fact that I cannot adopt Korotneff's notion and regard the cones with their apical apertures, which stand upon the upper surface of *Polyparium*, as buccal cones with buccal apertures. I am well aware that in anthozoal polyparies non-tentaculigerous personæ occur in many forms which may become degraded almost into simple pores; but to transfer such a conception to the elevations in question on the surface of *Polyparium* seems to me inadmissible, considering the position which these structures occupy, with relation to the internal spaces separated by septa, in the gastral cavity of *Polyparium*. I regard these cones rather as tentacles having a large aperture at the apex, and deny to *Polyparium* the possession of any buccal aperture, gastral tube, or central gastral cavity. But this absence of a buccal aperture must be taken only in a morphological sense, as I have no reason for disputing that possibly the apertures at the apex of the tentacles in this animal may be mouth-orifices or apertures of inception. From the investigations of R. Hertwig * upon different groups of the Malacodermata we are already acquainted with a similar reduction of the tentacles in the Hexactiniæ and Paractiniæ, so that in the Liponemidæ (*Polystomidium* and *Polysiphonium*), the Sicyonidæ (*Sicyonis*), and the Polyopidæ (*Polyopis*) these structures are so modified and widely opened at the apex that they exactly resemble the "buccal cones" of *Polyparium ambulans*; and yet Hertwig is quite inclined to admit that inception of nourishment occurs through these wide terminal openings of the tentacles.

But if these "buccal cones" of *Polyparium ambulans* are tentacles, their position with relation to the "internal chambers," to the internal cavity of the animal chambered by septa, may be shown to be in agreement with the normal conditions of an Actinid, so soon as we admit the interpretation of *Polyparium* as an astomatous Actinid and carry it out in detail.

Then, however, arises the double question :—On what part of the polyparium are we to place the lost mouth and the parts surrounding it? and to what processes is such a *lipostomy*,

* Report on the Scientific Results of the Voyage of H.M.S. 'Challenger,' Zoology, vol. vi. (1882), Actiniaria, pp. 63, 97, 101.

as the condition might be designated with reference to analogous phenomena among the sponges, to be ascribed?

Now we might assume that such an astomatous condition was produced in the very earliest period of larval life, so that, there being no formation of an œsophagus and corresponding central gastral space, the first-formed septa grew towards one another and became united; but in this way there would result a series of partitions forming transverse chambers, and continually increasing in number; the place for the mouth, which never became formed, would upon this supposition be no doubt localized upon the upper surface and in the median line of the band-like body.

Such an assumption, however, is opposed by a structure in the body of *Polyparium* which rather indicates a different interpretation and other processes. This is the figure of the polypary, which is certainly described, but not further specially applied, by Korotneff. For while the transverse chambering of the band-like body produced by polyp-septa appears an exceedingly abnormal structure, it becomes still more remarkable from the fact that the two long lateral margins of the body are so differently constructed that they cannot well be referred to the uniform periphery of an Actinia or Coral extended longitudinally. And these differences between a rounded-off and a bordered longitudinal margin are so far continued upon the upper surface which bears the "buccal cones," that the latter on the last-mentioned margin are placed close together like palissades, while they stand separately near the other margin. This asymmetry of *Polyparium* seems to me to furnish an indication of the derivation of this singular animal form.

I imagine from this that this astomatous polyp was produced in this way—a typically constructed Actinid with a central mouth and complete circlet of tentacles underwent at some time, and in a manner still to be elucidated, a division by which a portion of the body of the polyp was separated at the lateral margin of the mouth-aperture; perhaps the process took place in a form in which a long, fissure-like mouth was situated between the two directional chambers, and parallel to its long diameter. If then, after such a process of division, a union of the margins of the wounded surface took place, this would produce the form of a polyp without any central gastral space, with an internal cavity transversely chambered by septa, and at the same time with two dissimilar margins, one of which was originally adoral, the other aboral and a segment of the original wall. That margin of *Polyparium* on which the tentacles ("buccal cones") stand in close proximity would probably be equivalent to the latter.

Besides the phenomenon known since Dalyell's time *, that fragments separate from the body of an Actinia and become developed into young Actiniæ, we know of spontaneous processes of division in polyps with and without hard parts, and some produced by external injuries, so that we are led to believe that spontaneous divisions may be caused or hastened by external influences. Bennet † has described the spontaneous process of division, effected in three hours, of an *Anthea cereus*; this process is somewhat different from that in which the usually incomplete division is preceded by the formation of new organs, such as a buccal aperture. Lacaze-Duthiers ‡ obtained *Caryophyllice* which in collecting had been split longitudinally, and kept them alive in this condition for two months. Semper § has described the most singular processes of division of corals belonging to the genus *Diaseris*, and thinks that here the breaking-up of the lobate forms might be favoured by external influences. Whether in the first two cases the spontaneously-formed or artificially-produced fragments are able to regenerate themselves I cannot say; the portions observed by Bennet produced by spontaneous division appear to have completely closed their wounds, but whether perfect union took place was not ascertained by anatomical examination; experiments which I formerly made in this direction upon Actiniæ in aquaria furnished no results. That, as in the instance described by Lacaze-Duthiers, divided polyps remain alive for a long time, is in agreement with the well-known tenacity of life in many of these animals. The case of *Polyparium ambulans*, which now occupies us, is approached more nearly by the observations communicated by Semper (*l. c.*), especially that of a *Fungia*, which is figured by him on pl. xxi. fig. 4. In this instance the fragment of a *Fungia* was separated by force from the whole, a fragment with transversely-placed septa, which may be compared with *Polyparium ambulans* with its transverse partitions. On the margins of this fragment the animal regenerated itself with formation of new buccal apertures.

Under such circumstances the fragment of a polyp without a buccal aperture would be more likely to remain "astomatous" and to close the wounded surface by cicatrization, if the widely-opened tentacles retained upon it rendered inception of nourishment possible; nay, under certain conditions, to be

* 'Rare and Remarkable Animals of Scotland,' vol. ii. (1848), p. 232.

† 'Proceedings of the Natural-History Society of Dublin,' vol. iv. (1884), pp. 208–212.

‡ 'Archives de Zoologie expérimentale,' tome vi. (1877), p. 382.

§ Zeitschr. wiss. Zool. Band xxii. (1872), p. 269.

referred to hereafter, such a form, with a sufficiency of food, would enter upon a process of growth, such as is assumed by Korotneff in the case of *Polyparium ambulans*, and would then more and more develop the band-like form.

But what is to be regarded as the original form from which *Polyparium ambulans* might have been derived? Notwithstanding Lacaze-Duthiers's * observations upon the Actinia-like living creatures which separated off from a *Caryophyllia*, polyps forming hard parts may well be left out of consideration in this case. Such structures as the acetabula standing on the foot-surface are known in no Malacodermatous form, so far as I am aware. To assume that these structures might have become developed in *Polyparium ambulans* under its peculiar conditions of existence is a convenient mode of escaping from the difficulties which at present assail us, perhaps only in consequence of our insufficient knowledge of Actinid forms.

On the other hand, the "buccal cones," which I have interpreted as tentacles, furnish a probable indication of the Sicyonidæ, Liponemidæ, and Polyopidæ described by R. Hertwig. Now all these animals, without possessing any close affinity to each other, are inhabitants of the deep sea. May the "buccal cones" of *Polyparium ambulans* possibly indicate that the starting-point of its development is to be sought in a deep-sea form of Actinia?

But then the question already touched upon cannot be avoided, namely whether *Polyparium ambulans* is to be considered an animal produced by regular development, or whether it is to be placed among those animals, at present certainly but imperfectly known, which, under the influence of external conditions, are brought into a course outside regularity and become developed further in this course. I would denominate such animals *paranomally* developed, in opposition to the regularly or *eunomally* developed animals. Or, to express the case otherwise, Is *Polyparium ambulans* a phylogenetically-developed species at some time propagating by sexual processes? or have we in it a form diverging from the typical form, produced in each individual case by the action of external conditions, and which either dies out as such in each instance or, perhaps, may produce similar organisms by asexual reproduction?

I may adopt this last case as the conclusion of these speculative considerations, and in accordance therewith interpret *Polyparium ambulans* as a fragment separated off from a

* *Loc. cit.* p. 382.

probably deep-sea form of Actinia by external influences, such as the bite of a fish or the nip of a crab's claw, which has been brought up from its original locality into shallow water, where it finds an abundance of food in the well-populated sea, and can obtain therefrom by inception through the buccal cones such plentiful nutriment that it not only brings the original wounded surface to cicatrize, but grows on more and more into a band-like shape. In this case the peculiarities of the transverse musculature and the locomotive apparatus may have been derived from the original form, which is still unknown to us. For the tripartition present in the foot I have no interpretation.

Such an explanation, as will be seen, approaches in a certain way to the interpretation which Günther * has given of the Leptocephalidæ. Accidental but constantly recurring circumstances carry away eggs or young brood of fishes which spawn in the littoral waters into pelagic regions or currents, and here, under unusual conditions of existence, ensues the development of these peculiar forms of fishes, which, by their possession of a gelatinous mass around the vertebral column, perhaps differ as much from other fishes as *Polyparium ambulans* from normally constructed Malacodermata. The paranomally developed Leptocephalidæ are incapable of reproduction as such; only the constant recurrence of similar conditions calls these creatures into being.

Perhaps also those animals which have recently been known exclusively as inmates of aquaria are to be interpreted in the same way. I refer to *Trichoplax adhærens*, F. E. Schulze †, and perhaps the singular *Ctenodrilus monostylos*, Zeppelin ‡, may also be placed in this category. If these are also paranomally developed animals, they differ from the Helmichthyidæ by the possession of the power of reproduction; but so far as is yet known they are capable only of asexual propagation; the starting-point of *Trichoplax* is indeed quite unknown, but for *Ctenodrilus monostylos* it is not far to seek. We might also refer to *Protohydra Leuckarti*, R. Gr., and suppose that this form, in which we only know asexual reproduction, becomes specially developed in its habitat, the oyster-park of Ostend, under circumstances which approach those of an aquarium, if it were not that Reinhard § mentions the occurrence of this animal in the Black Sea, but without any indication of the special circumstances. I adduce

* 'Introduction to the Study of Fishes' (1880), p. 181.
† Zool. Anzeiger, Jahrg. vi. (1883), p. 92.
‡ Zeitschr. für wiss. Zool. Bd. xxxix. p. 615.
§ Zool. Anzeiger, Jahrg. vi. (1881), p. 592.

these animals also, because from its organization we may suppose that *Polyparium ambulans* likewise reproduces asexually, but, notwithstanding its considerable size, no sexual products are found in it.

From all this therefore I come to the conclusion that *Polyparium ambulans* is an astomatous individual animal, separated by external influences from a single-mouthed Actinia furnished with widely open degenerated tentacles, and add the further supposition that this animal has grown by paranomal development under shallow-water conditions of life into the band-like form, and as such may be capable of asexual reproduction, perhaps by fission.

This fabric of speculations may perhaps collapse as soon as the animal which has given occasion for it shall be more exactly known than at present by further investigations, in which, amongst other things, the terminal chambers of the body will have to be examined. My purpose is attained if by these pages the attention of naturalists is directed not only to the animal discovered by Korotneff, but also to the processes of what I have denominated paranomal development, which call for further investigation.

XXXIV.—*On a remarkable new Species of* Cladorhiza *obtained by H.M.S. 'Challenger.'*

By Arthur Dendy, B.Sc., F.L.S., Assistant in the Zoological Department of the British Museum.

[Plate XV.]

In returning the collection of Hexactinellid Sponges dredged by H.M.S. 'Challenger' to the Natural-History Museum, after the completion of his examination of the group, Professor F. E. Schulze also returned a very remarkable little Monaxonid sponge, which had been accidentally sent to him with the others. As the specimen in question did not come into my possession until after the completion of the Report on the 'Challenger' Monaxonida by Mr. Ridley and myself, I have thought it desirable to give an account of it in this place. It is a new and very well-marked species of the genus *Cladorhiza*, M. Sars; and I propose for it the name *Cladorhiza pentacrinus*, owing to the resemblance which it bears to the Pentacrinoid larva of *Antedon*. The specimen was, unfortunately, received in the dry condition.

Cladorhiza pentacrinus, n. sp.

Sponge (Pl. XV. fig. 1) stipitate, consisting of a long, slender stem, terminating above in a subglobular body, which bears a circlet of short pinnæ or arms *, curving upwards and inwards over the top. The stem terminates below in a number of very slender, long, branching rootlets. Total length of the single specimen 24 millim. Length of body and pinnæ together 4 millim. Length of stem 11 millim. Diameter of body 2 millim. Surface of body and pinnæ hispid, owing to the projection of some of the megasclera. Colour white. Oscula and pores unknown.

Skeleton.—The skeleton is arranged much as usual in the genus *Cladorhiza*. The skeleton of the stem is formed of long, slender styli, arranged side by side longitudinally; in the head it breaks up into several radiating branches, one for each pinna. In the basal part of the head these branches are not very well defined, and the spicules composing them are rather loosely arranged. Although the pinnæ are curved the spicules forming their axes are straight, and hence it follows that the styli in any part are inclined at an angle to those lower down in the pinna (Pl. XV. fig. 2). The rootlets are formed by repeated dichotomous ramification of the stem. The styli are smaller in the head and pinnæ than in the stem, and they also become much smaller and slenderer in the rootlets as ramification proceeds, the extreme end of each rootlet being composed of a single long and very slender spicule (Pl. XV. figs. 3, 5). They are arranged throughout with their apices pointing upwards.

Spicules.—(*a*) Megasclera: These are the usual long, slender, fusiform styli (Pl. XV. figs. 4, 5); they are frequently blunted at the apices, and in full-grown examples they are narrowed at the base. They vary greatly in size, measuring when full-grown (in the uppermost part of the stem) about 1·5 by 0·02 millim. They are smaller in the head and arms and in the rootlets. The terminal spicules of the latter measure only about 0·0063 millim. in diameter, and they have faintly developed oval heads, forming the extreme points of the rootlets.

(*b*) Microsclera: These are of two kinds: (1) tridentate anisochelæ (Pl. XV. figs. 6, 7, 8), of the ordinary general Cladorhiza form, but with a well-marked specific character. The three teeth at the large end are of considerable size, and the shaft is curved and fimbriated as usual in the genus. The

* I am unable to give the exact number of the arms, but there are about ten or twelve. Judging from the allied *Crinorhiza* forms, I am inclined to attach no great importance to the exact number.

peculiarity consists in the form of the three teeth at the small end of the spicule. These are elongated, slender, curved, and fang-like; they are not flattened. They are attached by a rather narrow base to the tubercle and taper gradually to a sharp point at the apex, which is directed towards the large end of the spicule. Their form will be best understood from the illustrations. These spicules measure 0·038 millim. in length and 0·022 millim. across from apex to apex of the two lateral teeth; they are enormously abundant in the head and pinnæ, forming a dense incrustation upon the latter, especially upon their inner surfaces (Pl. XV. fig. 2). (2) Large sigmata (Pl. XV. figs. 9, 10), measuring 0·11 by 0·0042 millim.; also very abundant.

Locality. Station 169, July 10, 1874, lat. 37° 34′ S., long. 179° 22′ E. North-east from New Zealand, 700 fathoms, blue mud; bottom temperature 40° Fahr.

This species is very remarkable (1) for its minute size, (2) for its peculiar external form, and (3) for the structure of the small end of the chelæ.

It is, with a single exception, the smallest sponge known to me; the exception is *Chondrocladia clavata*, Ridley and Dendy *, which belongs to a closely-allied genus, and is only slightly smaller than the present species, which it resembles somewhat in external form. In considering the size, however, the possibility must of course be borne in mind that the single specimen present may be not yet full-grown.

As regards external form, *Cladorhiza pentacrinus* is a very good example of the general rule that all deep-sea Monaxonida have a definite and symmetrical shape †. It makes some approach to the "*Crinorhiza*-form" found in other deep-sea species of the genus, but it differs from all species possessing that form in having the pinnæ short and curved inwardly. This peculiar curvature of the pinnæ suggests the possibility that they have the power, in life, of bending and unbending like the arms of a crinoid. They differ very markedly in appearance from the long, rigid, radiating pinnæ of typical *Crinorhiza*-forms (e. g. *Cladorhiza longipinna*, Ridley and Dendy ‡), the function of which processes is doubtless to support the sponge on the soft mud on which it lies. This function of support cannot be fulfilled by the pinnæ of *Cladorhiza pentacrinus*, because, in the first place, they are not disposed in a suitable manner, and, in the second place, it is almost certain that the body of the sponge is raised far above

* Report on the Monaxonida dredged by H.M.S. 'Challenger,' p. 100, pl. xx. figs. 1, 1*a*.

† *Cf.* Report on the 'Challenger' Monaxonida, p. 262.

‡ Ibid. p. 92, pl. xx. fig. 2.

the surface of the mud upon the long, slender stalk, the animal being anchored in the mud by means of the delicate rootlets. This view of the position of the body in life is confirmed by the fact that there is an egg-capsule of some mollusk attached to the stem just at the point where it branches into rootlets, and in order that this attachment might take place, the stem must have been entirely out of the mud. In presence of the facts now ascertained * with regard to the existence of contractile (muscular) tissue in the Porifera, there is no great improbability involved in the supposition that the arms or pinnæ of *Cladorhiza pentacrinus* may be endowed with some slight power of motion, although it is very difficult to see how any advantage to the sponge could arise from the possession of such a power. Unfortunately the condition of the specimen quite precludes any investigation as to the presence of contractile fibre-cells (*myocytes*, Sollas) in the arms. In a species of the allied genus *Esperella* (*E. Murrayi*), however, it has been shown by Ridley and Dendy † that there is a well-developed system of undoubtedly contractile fibrous tissue, whose function is to open and close the peculiar crack-like pore-areas, and thus to regulate the supply of water.

In the peculiarity of the chelæ the species stands quite apart from all others of the genus, in which, it will be remembered, the small end of the chela is usually very poorly developed.

The species is of further interest owing to the fact that no other Monaxonid sponges were obtained at the same station, which is hence totally unrepresented in the Report on the Monaxonida.

EXPLANATION OF PLATE XV.

Cladorhiza pentacrinus, n. sp.

Fig. 1. The entire sponge, ×6: *a*, the egg-capsule of some mollusk attached to the stem.
Fig. 2. The upper portion of one of the pinnæ, ×35, showing the arrangement of the spicules.
Fig. 3. Two terminal rootlets, × 130, showing the arrangement of the spicules.
Fig. 4. A large stylus from the upper part of the stem, ×130.
Fig. 5. The terminal stylus of a rootlet, ×250.
Fig. 6. A tridentate anisochela, front view, ×700.
Fig. 7. Ditto, side view, ×700.
Fig. 8. Ditto, end view, from the large end, ×700.
Fig. 9. A full-grown sigma, ×700.
Fig. 10. A smaller sigma, ×700.

* *Cf.* Sollas, article "Sponges" in 'Encyclopædia Britannica,' ed. ix. p. 419; and Ridley and Dendy, Report on the 'Challenger' Monaxonida, Introduction, chap. ii.

† Report on the 'Challenger' Monaxonida, pp. xxx, xxxix, 68, pls. xiii., xiv., xlviii.

XXXV.—*On the Classification of the Diplopoda.*

By R. Innes Pocock, Assistant Naturalist British Museum.

Of the naturalists who since the time of Brandt have paid attention to the Diplopoda, no two have come to the same conclusions concerning the classification of the group, and every one seems to have failed to appreciate fully the true value of the characters which serve as signs of affinity, or the converse, between its various divisions.

In the case of the older authors this has, of course, been due to ignorance of the structures which by later writers are considered to be of the greatest systematic importance; for it is only comparatively of recent years that the copulatory feet have been studied, and the extent of the modifications presented by these organs fully realized.

Taking into consideration existing forms there are four genera of Diplopoda which may be selected as examples to illustrate the modifications of structure presented by the group. These four genera are the representatives of as many divisions; but since these divisions are by no means equal in value, it is desirable to decide the exact position that each ought to occupy with regard to the others. For this purpose it will be necessary shortly to treat of the structure of each of these genera in turn, and briefly to state the position that has been assigned to the division of which it has been taken as a type by naturalists who have written most extensively on the subject.

The four genera in question are—*Polyxenus*, *Glomeris*, *Iulus*, and *Polyzonium*.

By Brandt and Newport *Polyxenus* was associated with the Polydesmidæ to form the suborder Monozonia; by Wood it was placed with the Polydesmidæ, Iulidæ, and Lysiopetalidæ in his suborder Strongylia; but in 1872 M. de Saussure, in his work upon the Mexican Myriopoda, suggested that further observations into its structure would probably lead to the abandonment of the idea that any near relationship exists between *Polyxenus* and the other Diplopoda. Taking apparently this suggestion into consideration, and possessing besides greater knowledge of its anatomy, Dr. Meinert, in his paper on the Chilognatha of Denmark, divided the latter group into two sections—one to contain *Polyxenus*, the other the Glomeridæ, Iulidæ, and Polydesmidæ. But to these sections he gave no names. This deficiency was, however, in 1884, supplied by Dr. Latzel, who, using the name Diplopoda as synonymous with the Chilognatha of Meinert, restricted the

latter group to the families Glomeridæ, Iulidæ, Polydesmidæ, &c., gave to *Polyxenus* (Meinert's other section) the name Pselaphognatha, and made them both suborders of his order Diplopoda. This arrangement was adopted by Dr. Haase ('Schlesiens Diplopoden') in 1886, and in this position *Polyxenus* will probably remain.

The characters by which it may be separated from all the other Diplopoda are as follows:—The body is soft and clothed with tufts of scale-like hairs; there is a distinct labrum; the second pair of jaws do not form a plate resembling the gnathochilarium; there are no foramina repugnatoria; the anus is in the last segment but one.

Against the third and fourth of these distinctions it may be urged that no true gnathochilarium is present in *Siphonophora*, and that there are no foramina repugnatoria in the Chordeumidæ. To the former objection reference will be made later on; with regard to the latter it may be said that the whole organization of the Chordeumidæ points to close relationship with the Iulidæ, and that therefore it is fair to assume that the absence of foramina repugnatoria in the former family is due to atrophy. This of course may be, and very possibly is, the case with *Polyxenus*; but until allied forms possessing them be known, the assumption that these glands have never existed, as such, can certainly be defended.

As opposed to the above characters of *Polyxenus*, for which as a group-name the term Pselaphognatha (Latzel) may be retained, the characters of the rest of the Diplopoda, or, as Dr. Latzel has called them, the Chilognatha, may be briefly summarized as follows:—Body hard and chitinous, destitute of tufts of scale-like hairs; there is no distinct labrum; the second pair of jaws form a plate (the gnathochilarium); foramina repugnatoria are present; the anus is in the last segment.

Within the limits of the group Chilognatha thus defined fall the three remaining genera *Glomeris*, *Iulus*, and *Polyzonium*.

In 1865 Wood recognized that the peculiarities of the genus *Glomeris* are sufficient to warrant the formation for its reception of a group equivalent to the Monozonia and Trizonia of Brandt taken together. For this group he retained the old name Pentazonia, and, abolishing the Monozonia and Trizonia, gave to the Iulidæ, Polydesmidæ, and Lysiopetalidæ the name Strongylia. But although with the views of Wood concerning the affinities of *Glomeris*, those of M. de Saussure and of Mr. G. C. Bourne (Journ. Linn. Soc. xix.

p. 161) are more or less in accord, Drs. Meinert, Latzel, Berlese, and Haase, merely retaining in their works the family names Glomeridæ, Iulidæ, Polydesmidæ, &c., have put forward no classification expressive of the idea that in the Chilognatha the Glomeridæ are a family highly specialized and sharply defined; or, in other words, these authors seem to have altogether underrated the systematic value of the distinguishing characters of the genus. These characters are as follows :—The copulatory appendages are at the posterior end of the body; the pleuræ are distinct; the anal plates free; the body is composed of not more than fourteen somites; the foramina repugnatoria form a single series in the dorsal middle line; the alimentary canal is not straight, and the tracheæ are branched.

With this may be compared the structure of *Iulus* as typical of the rest of the Chilognatha. The copulatory appendages are in the seventh segment of the body; the pleuræ are not distinct; the anal plates are surrounded by the last body-ring; the number of body-somites is great and variable; the foramina repugnatoria form a single series on each side; the alimentary canal is straight, and the tracheæ are tufted.

In the case of all the genera allied to *Iulus* it of course cannot certainly be known whether the tracheæ be tufted and the alimentary canal straight or not; but taking into consideration the other points in common, it is perfectly fair to presume, until evidence to the contrary is forthcoming, that resemblance will be found to exist in these particulars also.

With regard to the Polyzonidæ, Brandt was apparently led to the formation of his group Siphonizantia, Sugentia, or Colobognatha from his inability, owing to the absence of intermediate forms, to recognize the possibility of the conversion of the masticatory jaws of an *Iulus* into the sucking-proboscis of a *Polyzonium*.

A genus, *Platydesmus*, with mouth-parts in many respects intermediate in character between the masticatory and suctorial types, was, in 1843, described by Lucas, who pointed out its resemblances to *Polyzonium* and *Polydesmus*. By Newport, who abolished the group Sugentia and assigned to *Polyzonium* and *Siphonophora* a position near the Iulidæ in his division Bizonia, this genus, which was probably known to him solely from the description and figure published by Lucas, was regarded as allied to *Polydesmus*.

Gervais in this respect followed Newport, both authors being apparently misled by the superficial resemblance between the two genera afforded by the presence of keeled segments in each.

It is difficult to reconcile the acquaintance that Wood must have had with *Platydesmus* (redescribed as *Brachycybe*) with his failure fully to appreciate the relationship existing between the families constituting his suborder Strongylia and the family Polyzonidæ, to which he rightly considered this genus to belong. This failure led him to raise the group of suctorial Myriopods to the rank of a suborder, equal in value to the Pentazonia or Strongylia; to this suborder he gave Brandt's name Sugentia.

By M. de Saussure the Polyzonidæ, containing *Platydesmus*, were regarded as allied most nearly to the Iulidæ, and were treated simply as a family of the Chilognatha.

Yet Dr. Latzel, in 1884, gave to the Polyzonidæ Brandt's name Colobognatha, and made this group co-ordinate with the Chilognatha, comprising the Glomeridæ, Iulidæ, &c., thus clearly showing that, in his opinion, the relationship between the Glomeridæ and Iulidæ is greater than the relationship between the Polyzonidæ and the Iulidæ.

That a naturalist so careful and observant as his elaborate work on the Austro-Hungarian Myriopoda has shown him to be, should hold these views it is hard to believe, for all the points given above as characteristic of *Iulus* are equally characteristic of *Polyzonium*, and the only important respect in which the latter genus differs from the former is the possession of a suctorial proboscis instead of manducatory jaws.

If no intermediate form had been known, and if Dr. Latzel had only been acquainted with *Siphonophora*, the most aberrant genus of the group, the views expressed in his classification would even then have been unintelligible; but being familiar, at all events from descriptions and figures, with *Platydesmus*, and seeing from the modifications of its mouth-parts the method by which the proboscis might have been formed, it is astonishing that he should have committed himself to the restoration of the group of Diplopoda with suctorial mouths as opposed to the group of Diplopoda with masticatory mouths.

The distinguishing features of *Polyzonium* are as follows: —The head is pointed in front; the mandibles are reduced in size; the gnathochilarium is represented by a plate pointed anteriorly and laterally soldered to the sides of the head, thus forming the proboscis.

In the allied genus *Platydesmus* the head is more or less pointed in front, the mandibles are reduced, but the gnathochilarium is distinct, and not laterally soldered to the head, so that there is only a partially formed proboscis.

If these characters be compared with those of *Glomeris*,

given above, they sink into insignificance, for it will be seen that the differences between *Polyzonium* and *Iulus* are merely differences of degree and are due to degeneration, while the characters which separate *Glomeris* from *Iulus* are, at all events some of them, radically different in kind.

Although one of the particulars given by Dr. Latzel to distinguish the Chilognatha from the Pselaphognatha is the presence of copulatory feet in the former group, the fact that the copulatory feet of the Glomeridæ are not homologous with the copulatory feet of the Iulidæ appears to be entirely overlooked. Since they are not homologous their presence is not a sign of relationship, but the contrary; and it is less right, because of their presence, to unite the Glomeridæ, in which they occur at the end of the body, with the Iulidæ, in which they occur in the seventh segment, as opposed to Polyxenidæ, in which they are entirely absent, than it would be to unite the Polyxenidæ with the Glomeridæ as opposed to the Iulidæ, because in the two former they are absent from the seventh segment, or the Polyxenidæ with the Iulidæ as opposed to the Glomeridæ, because in the two former they do not occur at the end of the body. For it seems certain that their independent existence in these two families, Glomeridæ and Iulidæ, points to differentiation along diverging lines, and consequent departure from some ancestral form. Further, it is more than probable than this ancestral form was without copulatory feet, for it does not seem likely that these organs, if originally existing in the seventh segment, should have entirely disappeared in the Glomeridæ, or, if once acquired at the end of the body, should have entirely disappeared in the Iulidæ; still less likely does it seem that they were present in some position other than the seventh segment or the posterior end of the body; for if so all trace of their former existence has entirely and independently disappeared in the Glomeridæ and the Iulidæ, and their place has been taken by organs functionally similar but morphologically different.

Assuming, then, on these grounds that the ancestral Chilognath was without copulatory feet, *Polyxenus* certainly, in this respect, more nearly resembles this ancestor than does either *Glomeris* or *Iulus*, and therefore since *Glomeris* and *Iulus* have been evolved along different lines from this *Polyxenus*-like ancestor, it follows that, so far as the copulatory feet are concerned, the difference between *Polyxenus* and *Iulus* or *Polyxenus* and *Glomeris* is less than the difference between *Iulus* and *Glomeris*, and that therefore it is, at all events, misleading for Dr. Latzel to advance as a character by which *Glomeris* and *Iulus* may be united together and

separated from *Polyxenus* the presence of these copulatory feet.

The occurrence of these organs in the Glomeridæ and Iulidæ is due to the existence of similar physiological requirements, but that the existence of similar physiological requirements in two groups is not a sign of affinity between them need now-a-days hardly be urged. It would be as justifiable to consider the branched tracheæ of *Glomeris* and *Scolopendra* to be a bond of union between the two genera as to think that the presence of the copulatory feet is a sign of affinity between *Glomeris* and *Iulus*.

The possession by the Glomeridæ of the branched tracheæ, referred to above, shows, as Mr. Bourne has pointed out, that great specialization has taken place; and great specialization signifies in this case great differentiation from the ancestral form, for it is very probable that the ancestor of the Chilognatha resembled *Peripatus* and the *Iulus*-like Myriopods in the possession of tufted tracheæ.

Another important particular in which the Glomeridæ and Iulidæ differ is the position of the foramina repugnatoria. Whether these glands be or be not homologous in the two groups it is difficult to say; but it seems that the suggestions made by Prof. Moseley (Encycl. Brit.) with regard to the stigmata of *Scutigera* are equally applicable to the apertures in question. However that may be, it is, by the way, an exceedingly remarkable thing that in the most highly specialized member of each of the two divisions of the Myriopoda (*Glomeris* in the one case and *Scutigera* in the other) a series of apertures, which in allied forms is found to be situated on each side of the body, exists as a single row in the dorsal middle line. Whether this single median dorsal series in *Glomeris* represents in reality the paired lateral series in *Iulus* must for the present be left an open question.

The straightness of the digestive tract in *Iulus* and the absence of distinct pleuræ in the body-rings, though characters of significance, are of less significance than the characters mentioned above, and the freedom of the anal valves in *Glomeris* is but a consequent of the incompleteness of the skeleton of the posterior somite.

Having now seen that the Diplopoda are divisible into two groups, the Pselaphognatha and the Chilognatha, and that the Chilognatha are in turn divisible into two groups, the first to contain the Glomeridæ, for which the name Oniscomorpha is proposed, and the second *Iulus* and allied genera and the closely-related but in some respects aberrant *Polyzonium*, it remains but to consider the structure of the

genera composing the second division, which may be called the Helminthomorpha, and to discuss the relationship that they bear one with another. As typical genera may be selected *Polydesmus*, *Lysiopetalum*, *Chordeuma*, *Iulus*, and *Polyzonium*, and the distinguishing characters of each of these are as follows:—

In *Polydesmus* the body is composed of not more than twenty segments; the mandibles have no basilar piece (cardo) and the gnathochilarium has no intergalea (promentum). The copulatory feet are formed from the anterior pair of the seventh segment, and they are external; the pedal laminæ (tracheal plates, Bourne) are mostly fixed.

In *Lysiopetalum* the number of segments is great and variable; the mandibles have the cardo and the gnathochilarium the promentum; the copulatory feet are formed from the anterior pair of the seventh segment, and they are more or less internal; the pedal laminæ are all free.

In *Iulus* the number of segments is great and variable, the mandibles have the cardo and the gnathochilarium the promentum; the copulatory feet are formed from both pairs of the seventh segment and are more or less internal; the pedal laminæ are mostly fixed (in a closely-allied genus, *Isobates*, they are free).

In *Chordeuma* the number of segments is thirty; the mandibles have the cardo and the gnathochilarium the promentum; the copulatory feet are formed from both pairs of the seventh segment and are more or less internal; the pedal laminæ are free; foramina repugnatoria absent.

In *Polyzonium* the number of segments is great and variable; the mouth-parts have undergone degeneration; the copulatory feet are formed from both pairs of the seventh segment and are more or less external; the pedal laminæ are free.

Setting aside *Polyzonium*, which in this respect it is not possible to compare, it will be seen from these short descriptions that *Polydesmus* differs from *Iulus*, *Lysiopetalum*, and *Chordeuma* in that the mandible is without the cardo and the gnathochilarium without the promentum, and further that in the possession of but one pair of external copulatory feet this same genus presents greater simplicity of organization. Greater simplicity of organization, except where degeneration has occurred, is usually an indication of greater affinity with the ancestral form, and therefore, assuming that the Helminthomorpha and the Oniscomorpha have sprung from a common ancestor, we should expect to find the resemblance between *Polydesmus* and *Glomeris* greater than the resemblance between, e. g., *Iulus* and *Glomeris*; and this seems to

be so, for in *Glomeris* the mandible is without the cardo and the gnathochilarium without the promentum, and the number of segments in *Glomeris* and *Polydesmus* is less than in any other Chilognath. From this latter fact it seems likely that the ancestral Chilognath was possessed of but few segments, an idea to which the existence of but few segments in larval forms lends great weight. And as bearing upon the same subject it is perhaps worthy of remark that *Polyxenus*, which in the palpiform character of its second pair of gnathites, and questionably in the absence of foramina repugnatoria, resembles, I believe, the ancestral Diplopod, also possesses a small number of segments.

Polydesmus then more nearly resembles the ancestor of the Chilognatha than does any other genus of the Helminthomorpha, and *Lysiopetalum* in the conversion of but one pair of appendages into copulatory organs resembles *Polydesmus*. But important as this one particular is as a sign of affinity, it is outweighed by the many points of resemblance between *Lysiopetalum* and *Iulus*. I have therefore associated the Lysiopetalidæ with the Iulidæ, Polyzonidæ, and Chordeumidæ in the suborder Iuloidea.

At the same time, however, it must be borne in mind that *Lysiopetalum* is intermediate between *Polydesmus* and *Iulus*, being more highly specialized than the former and less highly than the latter.

The conversion of both pairs of appendages of the seventh segment into copulatory organs shows close relationship between *Chordeuma*, *Polyzonium*, and *Iulus*—the Polyzonidæ, as M. de Saussure long ago suggested, appearing to be but degraded Iulidæ, and the Chordeumidæ only differing from the Iulidæ in the absence of the foramina repugnatoria, in the smaller size of the first segment, and in the possession of a smaller number of somites.

To sum up: *Polyxenus* in the possession of a small number of segments and in the pediform character of its second pair of gnathites shows comparatively but little specialization, and presumably therefore but little differentiation from the ancestor of the Diplopoda. The fusion of the second pair of gnathites into a plate, the gnathochilarium, characterized the ancestral Chilognath, which was further distinguished by the possession of tufted tracheæ (?), by the absence of the mandibular cardo and of the promentum in the gnathochilarium, and showed resemblance to the ancestral Diplopod by the presence of but few body-somites and by the absence of copulatory feet. From this Protochilognath sprang the Oniscomorpha and the Helminthomorpha. The former, undergoing

great specialization, acquired branched tracheæ and accessory feet to subserve copulation at the end of the body, the latter, retaining the tufted tracheæ, developed copulatory organs from the appendages of the seventh segment. The Polydesmidæ, in possessing comparatively few body-somites, no mandibular cardo, and no promentum in the gnathochilarium, show great approximation to the ancestor of the Chilognatha, and therefore to the ancestor of the Helminthomorpha, and are further shown to be the nearest living representatives of this latter by the conversion of the anterior pair of limbs alone of the seventh segment into copulatory organs and by the retention by these organs of their primitive external position. By possessing but one pair of copulatory organs the Lysiopetalidæ show relationship with the Polydesmidæ; but by the internal position of these organs and by the presence of a great and variable number of segments, of a mandibular cardo, and of a labial promentum, they show greater relationship with the Iulidæ. The conversion of the second pair of appendages of the seventh segment into a copulatory organ and the power to retract these within the segment distinguish the Iulidæ. From the Iulidæ the Polyzonidæ show degeneration by the reduction of the mandibles, and possibly the Chordeumidæ by the loss of the foramina repugnatoria.

To show in a condensed form the views here expressed as to the exact position to be assigned to the different families of the Diplopoda the following classification has been drawn up. But it must be borne in mind that, except in that greater value has been given to some groups and less to others, this classification, so far as concerns the relationship of the Polydesmidæ, Lysiopetalidæ, Iulidæ, and Chordeumidæ, is almost identical with that formulated by Dr. Berlese in 1886, and, so far as concerns the position of the Glomeridæ, Polyxenidæ, and Polyzonidæ, is little more than a modification of that suggested by M. de Saussure in 1872. That the ideas of this latter naturalist have received so little attention from subsequent writers is a matter to me of no little surprise.

It will be observed that no place has been assigned to the numerous extinct forms of Diplopoda. My excuse for the omission must be my ignorance of the structure of these fossils. Indeed, the knowledge possessed even by those who have especially studied this branch of the subject is, from the nature of things, but limited, and its extent may be perhaps to a certain degree estimated by the fact that Mr. Scudder has recently confessed, with an honesty which disarms comment, that certain portions of an organism described by him

as a new genus of Diplopods belonging to the Archipolypoda, a group of which he is himself the founder, are in reality fragments of a fossil fern!

Concerning the position that the Diplopoda should occupy with regard to the Chilopoda and Hexapoda, I believe the relationship between the two last-named to be greater than the relationship between the Chilopoda and Diplopoda. At all events the recent careful researches into the organization of *Scolopendrella* and of the Thysanura, carried on by Drs. Haase and Grassi, demonstrating as they do the affinity between the Hexapoda and the Chilopoda, are sufficient justification for the abolition of the name Myriopoda and for the elevation of the groups Chilopoda and Diplopoda to the rank of classes.

For the sake of comparison I have drawn up tabular lists of the classifications of the Diplopoda formulated by various naturalists.

Newport, 1844 (Trans. Linn. Soc. xix. p. 276).

Order CHILOGNATHA.

Tribe I. Pentazonia.

Fam. *Glomeridæ*.

Tribe II. Monozonia.

Fam. *Polyxenidæ*.
Polydesmidæ.

Tribe III. Bizonia.

Fam. *Iulidæ*.
Polyzonidæ.
Siphonophoridæ.

Wood, 1865 (Am. Phil. Soc. xiii. p. 246).

Order CHILOGNATHA.

Suborder I. Pentazonia.

Fam. *Glomeridæ*.

Suborder II. Strongylia.

Fam. *Polyxenidæ*.
Polydesmidæ.
Iulidæ.
Lysiopetalidæ.

Suborder III. Sugentia.

Fam. *Polyzonidæ*.
Siphonophoridæ.

Saussure, 1872 (Miss. Sci. Mex. vi. p. 9).

Order CHILOGNATHA.

Suborder I. = Fam. *Glomeridæ.*
Suborder II. = *Polyxenidæ.*
Suborder III. = *Polydesmidæ.*, *Iulidæ.*, *Polyzonidæ.*

Latzel, 1884 (Myriop. österr.-ungar. Monarchie).

Order DIPLOPODA.

Suborder I. PSELAPHOGNATHA.
Fam. *Polyxenidæ.*

Suborder II. CHILOGNATHA.
Fam. *Glomeridæ.*
Polydesmidæ.
Chordeumidæ.
Lysiopetalidæ.
Iulidæ.

Suborder III. COLOBOGNATHA.
Fam. *Polyzonidæ.*

Berlese, 1886 (Bull. Soc. Ent. Ital. p. 42).

Suborder CHILOGNATHA.
Fam. *Glomeridæ.*
Polydesmidæ.
Iulidæ.

Subfam. Lysiopetalidia.
Iulidia.
Chordeumidia.

Mihi.

Class DIPLOPODA.

Subclass 1. *PSELAPHOGNATHA.*
Fam. *Polyxenidæ.*

Subclass 2. *CHILOGNATHA.*
Order 1. ONISCOMORPHA.
Fam. *Glomeridæ.*

Order 2. HELMINTHOMORPHA.
Suborder 1. POLYDESMOIDEA.
Fam. *Polydesmidæ.*

Suborder 2. IULOIDEA.
Fam. *Lysiopetalidæ.*
Iulidæ.
Polyzonidæ.
Chordeumidæ.

Class Hexapoda. Class Chilopoda. — Foraminibus genitalibus in segmento posteriore positis. Segmentis non ultra pari pedum uno instructis. Tribus pedum paribus in maxillas mutatis. Spiraculis in parte corporis laterali sitis.

Class Diplopoda. — Foraminibus genitalibus in parte corporis antica positis. Segmentis binis pedum paribus plerumque instructis. Duobus pedum paribus in maxillas mutatis. Spiraculis in parte corporis inferiore sitis.

Subclass 1. *PSELAPHOGNATHA.*

Ano in segmento penultimo posito. Maxillis secundi paris pedibus similibus. Foraminibus repugnatoriis nullis. Labro discreto. Corpore molli fasciculisque pilorum ornato ..... *Polyxenidæ.*

Subclass 2. *CHILOGNATHA.*

Ano in segmento ultimo posito. Maxillis secundi paris laminam formantibus. Labro haud discreto. Foraminibus repugnatoriis manifestis. Corpore crustato fasciculisque pilorum haud ornato.

Order 1. ONISCOMORPHA.

Pedibus, qui instrumentum copulativum forment, segmento ultimo additis. Tracheis ramosis. Foraminibus repugnatoriis seriem unam in dorso medio formantibus. Pleuris distinctis: laminis ani haud segmento posteriore cinctis ..... *Glomeridæ.*

Order 2. HELMINTHOMORPHA.

Pedibus segmenti septimi in instrumentum copulativum mutatis. Tracheis fasciculis similibus. Foraminibus repugnatoriis seriem unam quoque latere formantibus. Pleuris haud distinctis. Laminis ani segmento posteriore circumdatis.

Suborder 1. Polydesmoidea.

Instrumento copulativo ex anteriore pedum pari formato, externo: corpore segmentis non ultra viginti composito. Cardine mandibulæ nullo, promento gnathochilarii nullo ..... *Polydesmidæ.*

Suborder 2. Iuloidea.

Segmentorum numero semper majore quam viginti, plerumque magno varioque. Mandibula cardine instructa, gnathochilario promento. Pedibus copulativis plerumque internis.

A. Instrumento copulativo ex anteriore pedum pari formato. Numero segmentorum magno varioque ..... *Lysiopetalidæ.*

B. Instrumento copulativo e duobus pedum paribus formato.

1. Numero segmentorum magno varioque. Foraminibus repugnatoriis manifestis.
   (*a*) Mandibulis haud imminutis ..... *Iulidæ.*
   (*b*) Mandibulis imminutis ..... *Polyzonidæ.*
2. Numero segmentorum semper triginta. Foraminibus repugnatoriis evanidis ..... *Chordeumidæ.*

XXXVI.—*Descriptions of new or little-known South-American Frogs of the Genera* Paludicola *and* Hyla. By G. A. Boulenger.

Paludicola nebulosa.

Liuperus nebulosus, Burmeister, Reise La Plata, ii. p. 532 (1861).

Tongue subcircular, indistinctly nicked behind. Vomerine teeth none. Snout extremely short, much shorter than the diameter of the eye, somewhat similar to that of *Notaden Bennetti*; nostrils directed forwards; eye large; interorbital space about two thirds the width of the upper eyelid; tympanum distinct, circular, measuring half the diameter of the eye. Fingers short, depressed, first much longer than second; toes short, much depressed, webbed at the base, the web extending as a fringe to their tips; subarticular tubercles small, of toes conical; two very strong, compressed, sharp-edged metatarsal tubercles, inner largest; no tarsal tubercle; no tarsal fold. The hind limb being carried forwards along the body, the tibio-tarsal articulation reaches the axilla; tibia little longer than the skull. Skin smooth; no lumbar gland. Pale brownish above, with small scattered blackish spots; no cross bars on the limbs. From snout to vent 40 millim.

Mendoza.

Described from the type specimen (♀) in the Berlin Museum (no. 7374).

Paludicola albifrons (Spix).

Tongue small, elliptic, entire. Vomerine teeth none. Snout rounded, as long as the orbital diameter; nostril nearer the tip of the snout than the eye; interorbital space as broad as the upper eyelid; tympanum hidden. Fingers moderate, first not extending quite as far as second; toes moderate, free, not fringed; subarticular tubercles moderate,

conical; a small conical tubercle on the inner side of the tarsus; two large, oval, compressed metatarsal tubercles, nearer each other than the tarsal tubercle. The tibio-tarsal articulation reaches the posterior corner of the eye. Skin nearly smooth, with flat warts above; no lumbar gland. Greyish above, with numerous, insuliform, dark-edged spots; dark vertical bars on the upper lip and cross bars on the limbs; sides of throat black in the male. Two external subgular vocal sacs in the male. From snout to vent 30 millim.

Brazil.

Described from two specimens (male and young) from Porto Alegre in the Berlin Museum (no. 6800).

The larger metatarsal tubercles distinguish *P. albifrons* from *P. gracilis*.

Liuperus marmoratus, Burmeister ('La Plata,' ii. p. 532), is not identical with *P. albifrons*, as stated by Peters, but with *P. fuscomaculata*.

Paludicola Henselii, Peters.

Tongue elliptic, entire. Vomerine teeth none. Snout subacuminate, as long as the orbital diameter; interorbital space broader than the upper eyelid; tympanum small, very indistinct. Fingers moderate, first not extending quite as far as second; toes moderate, free, not fringed; subarticular tubercles moderate, not conical; a small tarsal tubercle; two small, oval, metatarsal tubercles, which are wider apart from each other than the inner from the tarsal tubercle. The tibio-tarsal articulation reaches the posterior corner of the eye. Back with numerous, nearly straight, longitudinal folds; no lumbar gland. Grey-brown above, lighter along the middle and the sides of the back; hind limbs with dark cross bands; a black band extends from the end of the snout, through the eye, to the side, obliquely descending and gradually widening from behind the eye; below this black band, from the end of the snout to the shoulder, a whitish streak, which is again edged below by a blackish streak bordering the lip; lower surfaces whitish, mottled with brown. Male with a large subgular vocal sac. From snout to vent 19 millim.

Rio Grande, Brazil.

Described from the type specimen (♂) in the Berlin Museum (no. 6806).

Paludicola Bischoffi, sp. n.

Tongue elliptic, entire. Vomerine teeth none. Snout

subacuminate, as long as the orbital diameter; interorbital space as broad as the upper eyelid; tympanum small, very indistinct. Fingers slender, first considerably shorter than second; toes slender, fringed, with a slight rudiment of web; subarticular tubercles moderate, not conical; a small tarsal tubercle; two small, oval, metatarsal tubercles, which are wider apart from each other than the inner from the tarsal tubercle. The tibio-tarsal articulation reaches the anterior corner of the eye. Skin smooth, with a few very fine oblique or sinuous folds above; no lumbar gland. Pale olive above, with darker insuliform spots on the back and cross bars on the hind limbs; a black band, edged above with a fine whitish line, extends from the end of the snout, through the nostril, the eye, and the ear, to the side, obliquely descending and gradually widening from behind the eye; lower surfaces whitish, mottled with brown round the jaw and on the throat and breast. From snout to vent 29 millim.

Mundo Novo, Rio Grande do Sul.

A single female specimen, obtained by Hr. Th. Bischoff.

Paludicola Olfersii.

Phryniscus Olfersii, Martens, Nom. Mus. Berol. p. 40.
Nattereria lateristriga, Steind. Verh. zool.-bot. Ges. Wien, 1864, p. 279, pl. xiv. fig. 2.
Paludicola Olfersii, Peters, SB. Ges. nat. Freunde, 1882, p. 62.

Tongue elliptic, entire. Vomerine teeth none. Snout subacuminate, nearly as long as the orbital diameter; interorbital space as broad as the upper eyelid; tympanum hidden. Fingers slender, first not extending as far as second; toes slender, free, not fringed; two small metatarsal tubercles, inner oval, outer round; no tarsal tubercle; no tarsal fold. The tibio-tarsal articulation reaches the anterior corner of the eye. Skin smooth, without folds; no lumbar gland. Pale brown above, with darker symmetrical markings and cross bands on the hind limbs; a light streak along the coccyx; a blackish band from the end of the snout to the groin, passing through the eye, gradually widening and obliquely descending from behind the eye; the band is sharply defined and finely white-edged above and between the eye and the shoulder; lower surfaces whitish, throat and breast mottled with brown. From snout to vent 28 millim.

Brazil.

A half-grown female specimen, one of the types, presented to the author by Professor Peters in 1882, is in the British Museum.

Liuperus elegans, Peters, of which I examined the type in the Berlin Museum, belongs to the genus *Hylodes*, and is very closely allied to *H. bogotensis*, Peters, from which it differs in the smaller digital expansions. The vomerine teeth, very indistinct, appear to be in two small rounded groups behind the line of the choanæ. *Liuperus nitidus*, Peters, is probably likewise not a *Paludicola*; but I could not examine the sternum.

Hyla marginata, sp. n.

Tongue broader than long, entire, posterior fourth free. Vomerine teeth in two transverse oval groups, close together, on a line with the posterior border of the choanæ, which are of moderate size and much larger than the eustachian tubes. Head moderate, broader than long; snout rounded, shorter than the diameter of the orbit; canthus rostralis angular; loreal region not very oblique, concave; nostril nearer the end of the snout than the eye; interorbital space broader than the upper eyelid; tympanum distinct, half the diameter of the eye. Fingers one-third webbed; a distinct rudiment of pollex; toes about three-fifths webbed; disks a little smaller than the tympanum; subarticular tubercles moderate; no tarsal fold. The tibio-tarsal articulation reaches halfway between the eye and the end of the snout. Skin smooth; belly with large granules; throat indistinctly granulate. Upper surface of head and tibia and back finely powdered with brown on a colourless ground; a few small dark brown spots on the head and back, one on each upper eyelid; a dark brown line from the end of the snout, along the canthus rostralis and supraciliary edge, above the tympanum, and along each side of the body as far as the sacral region, also along the outer side of the forearm and tibia; a transverse dark brown streak, edged above with white, above the vent and at the heel; a white line round the upper lip; lower surfaces colourless. From snout to vent 50 millim.

Mundo Novo, Rio Grande do Sul.

A single female specimen, collected by Hr. Bischoff.

Apparently related to *H. rubicundula*, R. & L.

Hyla Bischoffi, sp. n.

Tongue circular, entire, and slightly free behind. Vomerine teeth in a strong, scarcely interrupted, transverse series, on a line with the hinder edge of the choanæ, which are of moderate size and larger than the eustachian tubes. Head rather large, rather strongly depressed, slightly broader than

long; snout rounded, as long as the diameter of the orbit; canthus rostralis angular; loreal region very oblique, concave; nostril nearer the end of the snout than the eye; interorbital space as broad as the upper eyelid; tympanum very distinct, half the diameter of the eye. Fingers one-fourth webbed; a distinct rudiment of pollex; toes half-webbed; disks smaller than the tympanum; subarticular tubercles moderate; a very slight fold along the inner edge of the tarsus. The tibio-tarsal articulation reaches halfway between the eye and the end of the snout. Skin smooth above; belly and lower surface of thighs with large, throat with smaller, granules. Greyish or pale brown above, with or without large brown spots and a brown line along the middle of the head and anterior half of body; a dark brown band from the end of the snout to above the shoulder, passing through the nostril and the eye and over the tympanum; a dark brown line borders the upper and the lower lip; a dark brown streak along the outer side of the tibia; hinder side of thighs light, with vertical black bars; lower surfaces white. From snout to vent 55 millim.

Mundo Novo, Rio Grande do Sul.

Two female specimens, collected by Hr. Bischoff.

Allied to *H. pulchella*, D. & B., but well distinguished by the larger head with much more oblique lores.

Hyla zebra, D. & B.

Tongue circular, indistinctly nicked, posterior fourth free. Vomerine teeth in two small groups in the middle between the choanæ; latter moderate, a little larger than the eustachian tubes. Head moderately large, a little broader than long; snout rounded, nearly as long as the diameter of the orbit; canthus rostralis obtuse; loreal region nearly vertical; nostril nearer the end of the snout than the eye; interorbital space as broad as the upper eyelid; tympanum very distinct, half the diameter of the eye. Fingers one-third webbed; a distinct rudiment of pollex; toes two thirds webbed; disks a little smaller than the tympanum; subarticular tubercles moderate; a strong fold along the inner edge of the tarsus. The tibio-tarsal articulation reaches halfway between the eye and the end of the snout. Upper surfaces glandular, the glandules most distinct on the head and limbs, but present also on the back; belly and lower surface of thighs with large, throat with smaller granules. Brown above, with large blackish spots on the sides and blackish bars across the front and posterior sides of the thighs, alternating with lighter

bands; belly white, throat brown. From snout to vent 63 millim.

Buenos Ayres.

Described from one of the type specimens (♀) in the Paris Museum, kindly communicated by Prof. Vaillant.

XXXVII.—*Notes from the St. Andrews Marine Laboratory (under the Fishery Board for Scotland).*—No. VIII. By Prof. M'Intosh, M.D., LL.D., F.R.S., &c.

1. On a Post-larval *Labrus*, with Remarks on the Colour of Pelvic Fins.
2. On the Post-larval Condition of *Liparis Montagui*.
3. On a peculiar Teleostean Yolk-sac.
4. General Remarks on Post-larval Food-Fishes.

1. *On a Post-larval* Labrus, *with Remarks on the Colour of Pelvic Fins.*

While lately (middle of September) using the large mid-water net, which has proved so valuable in regard to the life-histories of marine forms, a young wrasse, about 11 millim. in length, was captured, which, from the length of the anal fin and other characters approaches *Labrus mixtus*, but appears to be only a post-larval example of *Labrus maculatus*, though further examination is necessary on this point.

This young wrasse shows boldly marked white touches on a greenish ground variegated with brown pigment. The general hue, indeed, is greenish brown with various bands and patches. Thus the head has two white touches (each somewhat crescentric in form) over the brain, and a transverse one in front of the dorsal fin. A brown band passes from the middle of the eye forward on the snout and in line with the brown bar on the tip of the mandible. Another brown bar extends from the eye downward and forward, a third touch occurs on the hyoid, and two or three bars exist elsewhere on the head. The eyes are pale greenish with golden arches superiorly, and a band of brownish red surrounds the pupil, except inferiorly, where it is almost absent. This reddish belt has a process anteriorly and posteriorly.

The body is conspicuously marked with eight white spots, the first being near the pectorals, the last in the centre of the base of the tail. These spots are situated above the lateral line. Five opaque white spots again occur above the former, two sending prolongations to the tip of the dorsal fin, and a

third partially. Four specks of white are placed along the ventral margin, two lying in the basal line of the anal fin. A few minute specks occupy the space between the latter and the larger upper series. Large silvery patches, again, extend from beneath the eye to the end of the abdomen. A few brown specks appear on the ventral surface in front of the pelvic fins, and two boldly marked brown touches lie in the median line between the latter and the anus.

Besides the white touches which enliven the dorsal fin an opaque brownish one occurs in front. The soft rays of this fin have not yet attained the proportionally elongated condition of the adult organ. The pectorals are large and somewhat transparent, their very rapid vibratory movement resembling that of *Hippocampus* and the Syngnathidæ. A brown bar, however, marks their fleshy basal region, which in these and many other post-larval fishes is much larger in proportion than in the adult—a condition probably connected with increased functional activity. The ventral fins are opaque white, with a brownish belt in front (anterior rays); this belt, moreover, joining a brown band which proceeds upward to the base of the pectorals, where it bends nearly at a right angle straight backward to the posterior part of the abdominal wall. The anal fin has a brown patch (covering two rays) in front. None of the blue, yellow, or orange, so common in the adult, had yet appeared.

After immersion in spirit only the dark pigment remains, and thus the body has a peculiarly blotched or speckled appearance posteriorly, while the head and abdomen are striped.

The colour of the ventral fins in the post-larval forms of diverse families of fishes is apparently a feature of moment. Thus the post-larval *Motella* has its enormous white ventrals tipped with black, as Alex. Agassiz clearly describes and figures. The young cod, haddock, and whiting have pure white ventrals terminated by a long whip-like process at the end of the second anterior (or outer) ray. The great ventrals of the post-larval ling are conspicuously tinted of an ochre-yellow. The colour of the huge ventrals of the fishing-frog is not mentioned by Günther or Agassiz, but it is not unlikely that the post-larval pigment in this form also is peculiar. The pelagic habits of many fishes at this stage are probably associated with these peculiar tints, just as both sides of most post-larval Pleuronectidæ are tinted for a time, as the ventral surface of the large abdomen of *Callionymus* at this stage is of a dusky blackish hue, and as the abdomen in certain post-larval *Cotti* is furnished with a broad and conspicuous belt of black.

It is interesting that rock-frequenting species, like the present form, *Cyclopterus*, and others, should display such vivid tints both in the post-larval and occasionally in the adult condition.

2. *On the Post-larval Condition of* Liparis Montagui.

In former notes * mention has been made of the ova and larval condition of this species. The chief peculiarities of the post-larval form, about 10 millim. in length, may now be indicated. In this specimen the notochord still projects superiorly from the tip of the tail, and the hypural edge is almost vertical. The caudal region with its fin-rays is bluntly conical.

A marked feature is the elevation of the first region of the dorsal fin and its wider rays, a differentiation perhaps indicating the relationship with a form in which such is present in the adult, or marking the region which in others becomes the first dorsal. This elevation disappears in the adult. The head and cheeks have a few black specks, and these also occur on the anterior region of the body. The pectorals are speckled in a similar manner. The elongated rays of these fins are not yet developed, so that this is a subsequent character; their margins trend evenly from the anterior part of the sucker backwards and upwards.

The difference in regard to the size of the eye of such a species as this and one of the post-larval Gadoids is marked, the large eyes of the latter being diagnostic, and probably associated with their greater adroitness and rapidity in catching minute prey.

3. *On a peculiar Teleostean Yolk-sac.*

One of the most interesting larval fishes of this season (1887) at the Laboratory was an unknown form (though there are some grounds for associating it with the gunnel), distinguished amongst all others with which we are at present acquainted by the remarkable peculiarity of the presence of a large portion of the liver in the yolk-sac. A full description, with figures, of this elongated and very hardy species will be given by Mr. Prince and myself in the "Researches" from the Laboratory; but it may be mentioned that the yolk-sac is directed downwards and forwards from the body of the fish, and is slightly opaque, while the oil-globule is of crystalline translucency and furnished with a thick protoplasmic investment. Though the globule is near the inferior border of the sac, yet it is close to the heart, from the shortness of the sac. The liver proceeds downwards on the left side, and extends

* Ann. & Mag. Nat. Hist. June 1885, and Reports to the Fishery Board for Scotland, 1885 and 1886.

posteriorly to the fundus of the sac, its tissue insinuating itself between the yolk and its proper covering and the yolk-sac. The rounded gall-bladder lies at the posterior and upper region of the latter, and after the absorption of most of the yolk and the consequent forward displacement of the oil-globule this large sac remained very conspicuous. The alimentary canal in the advanced forms presents two marked constrictions, one behind the gall-bladder and another a little in front of the anus, which occurs near the middle of the body, a feature, after absorption of the yolk-sac, that at once distinguishes them from the larval herring, in which the anus lies very far back. The conspicuous gall-bladder is also diagnostic when compared with the larval sand-eel, in which the anus is likewise more or less median in position.

4. *General Remarks on Post-larval Food-Fishes.*

There seems to be a community in habit amongst the post-larval Gadoids, especially, so far as present knowledge goes, in the case of the cod and whiting, though probably also in the haddock, just as there is a community in regard to their ova. In the early post-larval stages of the cod and whiting close resemblances exist, especially after preservation in spirit, but they are easily discriminated after reaching the length of about five eighths of an inch. They roam throughout the deeper parts of the neighbouring sea, but are not confined thereto, some being occasionally found in the upper regions and some in the shallow water (4–5 fathoms). They are met with, however, in greatest numbers in the regions near the bottom in their post-larval stages.

It is doubtful if the migrations described by Prof. G. O. Sars in the case of the cod can, in the light of present facts, be accepted as the rule in this or in allied species. The floating eggs are carried (if they are not already there) into shallow as well as into deep water, and thus the post-larval fishes are common in both regions. Most, however, probably occur on or near the grounds frequented by the adults, and hence it is that far from shore young post-larval forms are even more numerous than in shallow or other water near land. The same applies to certain flat fishes, such as the witch (*Pleuronectes cynoglossus*), the young of which keep near the ground frequented by the adult and do not migrate to any extent into other regions.

The older post-larval forms of the cod and its allies, as already described, seek in the various bays the margin of the rocks in search of the abundant food there; but it is not proved that there is any general migration from deep to shallow

water, as Prof. Sars thinks. Similar forms occur in deep water and in the neighbourhood of isolated rocks, such as the Bell Rock, and especially on the grounds frequented by the adult.

XXXVIII.—*A new Species of* Zygæna *from the Kurrachee Harbour.* By James A. Murray, Vict. Nat. Hist. Inst.*

Zygæna dissimilis, sp. nov.

(Ex Journ. Bomb. Nat. Hist. Soc.)

Anterior edge of head sinuately curved. *No groove running along it.* Length of the hammer from eye to eye 26 inches; from the middle 13 inches. Each of its hind lateral expansions 10 inches; its width near the eye 6·5 inches, or less than the length. Eye situated at the upper third of the external edge of the lobe of the head, and 2 inches below the outer edge of the nostril. Teeth very slightly oblique, as broad at base as long, with an indistinct notch laterally and serrated on both edges to near the tip. They are convex before and behind, with an oblong nodose prominence mesially at the base on the outer surface. The 1st dorsal arises from a little more than an inch inside the extreme hind edge of the pectoral fin; it is falcate in shape and measures along the curve to tip 25 inches; the greatest width to hind prolongation at the base 15·75 inches. Pectoral fin 18 × 12 inches, or one third longer than broad. Second dorsal arises from opposite the anal; it is triangularly concave behind, and not straight as depicted in the plates of *Zygæna malleus*, *Blochi*, and *Tudes* in Day's Fishes of India, and it has also an elongated process at base. Ventral fin 11 × 10·5 inches, also triangularly concave behind, and not straight as in the other species. Anal fin 7 × 11 inches, concave behind, the distance from its insertion to the tip of the elongate process of the ventral 5 inches. A pit at the root of the caudal; upper caudal lobe falcate, lower proportionally longer than in the other species. Colours brownish grey throughout, except a width of 10 inches on the under surface, and the under surface of the hammer, where it is white.

The following are the measurements of this species taken in the flesh :—

* From the 'Indian Annals and Magazine of Natural Science,' June 1887, pp. 90–92.

	feet.	inches.
Total length to tip of upper caudal lobe	10	$2\frac{1}{2}$
Length of upper caudal lobe.....	3	$1\frac{1}{2}$
„ lower „	1	$3\frac{1}{2}$
Height of 1st dorsal over curve.....	2	1
„ „ (vertical) to tip	1	9
Width of „ to tip of elongate process	1	3
Height of 2nd dorsal	0	8
Width of „	0	11
Length of pectoral fin.....	1	$6\frac{1}{2}$
Width „	1	0
Length of ventral fin	0	11
Width „	0	$10\frac{1}{2}$
Anal fin, length	0	7
„ width	0	11

Diameter of eye 1·25 inch ; width of mouth 9·75 inches.

Hindmost (5th) gill-opening smallest.

Loc. Kurrachee. Captured on the 20th April, 1884. Type in the Kurrachee Museum.

This species differs from all the known forms, first, by having its teeth serrated on the edges instead of smooth ; and, next, in having no prolonged groove along the entire front margin of the hammer. From *Z. malleus* by the less curvature of the head, also by the length of the hind margin of one side of the hammer being more than its greatest width near the eye, and by the shape and position of the fins, especially the 2nd dorsal and ventral fins, which are concave behind instead of being straight. It is nearest *Z. mokarran* (Günther, Cat. Fish. B. M.), but the length of the hind margin of one of the lateral expansions is greater than the width near the eye, instead of being equal as in that species, and the anterior margin of the hammer does not form a right angle with the lateral lobe.

This makes the third species of shark lately described from the Kurrachee Harbour. The first is *Carcharias Murrayi*, Günther, the next *Lamna Güntheri*, Murray, and the present one the third. It is a question now whether these three species extend their range along the Beloochistan and Bombay coasts.

XXXIX.—*Scent-organs in* Phryganidæ.

By Dr. Wilhelm Müller *.

When I first captured a male of *Sericostoma* (*S. personatum*, K. & Sp.), in August 1885, and, induced by the remarkable

* Translated from the 'Archiv für Naturgeschichte,' Jahrg. xxxv. pp. 95–97.

form of the head, dissected the animal, the inflated palpi, which, as is well known, give the head its peculiar appearance and cover it like a mask, at once reminded me of the scent-organs of the Lepidoptera, and especially the hair-tufts of the Satyridæ. There may, perhaps, be some hesitation about recognizing any resemblance in this instance, but at any rate the comparison led me to the correct interpretation of the organs in question, although at first it did not seem an easy matter to obtain any proof of the correctness of this interpretation.

To me it was a confirmation of my hypothesis that, as I satisfied myself from individuals taken *in copulâ*, these peculiarly modified palpi only occur in the males (which, however, has long been known). An experimental proof, usually to be obtained easily in the Lepidoptera, could not, however, be arrived at, and this was due to the fact that the animals could not be induced to unfold their scent-organs by pressure or similar manipulations, the cause of which is to be found in the peculiar mechanism of the process. Finally, an individual which I probably captured during courtship favoured me by spreading out his palpi and unfolding the hair-tufts lying in them, when the hair-tufts surrounded the head like a halo, and then I was able by pressure to prevent the animal from folding up the tufts. In this individual I remarked, as also did a second person, under whose nose I held the animal, a distinct odour nearly resembling that of vanilla, and thus is furnished the proof that the dilated palpi of the males of *Sericostoma* serve as scent-organs.

As a further observation bearing upon this subject I may state that of numerous male and female individuals of *Sericostoma personatum* which I kept alive in a large glass vessel, a male placed himself in front of a female and then unfolded his hair-tufts.

As regards the form and structure of the organs in question, having neglected to preserve the animals in spirits, I was

Fig. 1. Fig. 2.

Sericostoma personatum, K. & Sp.
1, Female; 2, male. *Mxp*, maxillary palpus.

confined to dry material and compelled to give up any investigation of the minute structure.

In the place of the four extended joints of the maxillary palpus which we find in the female (fig. 1), the male possesses a single terminal joint (fig. 2, *Mxp*) formed by the amalgamation of several joints. It is of a very peculiar form, nearly like a spoon. The margin turned away from the head is dilated inwards and closely applied to the margin of the corresponding joint of the other side. On the other side the spoons lie so close to the head that they seem to form a part of the latter and cover it in front like a mask; and thus is produced on all sides a very complete closure, which prevents the evaporation of the scented secretion within the spoons. The interior of these spoons is entirely filled with very fine hairs, which originate at the base of the spoons and on the side turned away from the head (of course on their inner surface). These hairs are pale coloured, slightly clavate, and attain a length of about 1 millim. As already stated, the animal is able to separate and spread out the palpi (how must remain unsettled for the present) and at the same time to unfold the tufts of hair.

Thus we find, as is generally the case in the scent-organs of the Lepidoptera, an enclosure which ordinarily protects the scented secretion from evaporation, and, on the other hand, an arrangement by which at the proper moment a large surface is presented for evaporation, so as to effect a great development of the scent.

In the Phryganidæ there are pretty frequently secondary sexual characters, and it seems not improbable that frequently, or at any rate in some cases, these have to do with scent-organs. I may refer in the first place to *Notidobia* *, in which, according to Brauer, the maxillary palpi are boat-shaped and stand in the same relation to the forehead as in *Sericostoma*, and, further, to *Aspatherium* †, in which the maxillary palpi in the male are short and strongly hairy, although not dilated. In *Ecclisopteryx* and *Halesus* ‡ there is in the male at the base of the hind wing a folded pouch with a pencil of hairs. A similar sac occurs, according to MacLachlan §, in the genus *Drusus*. Further, Fritz Müller states that on the maxillary palpi of the male *Grumichæ* there are hair-tufts which probably serve as scent-apparatus, as also "that in the wonderful antennæ of the males of *Peltopsyche* he is inclined to see scent-apparatus."

* Brauer, 'Neuroptera Austriaca' (Vienna, 1857), p. 43.
† *Loc. cit.* p. 42.
‡ *Loc. cit.* pp. 46, 47.
§ MacLachlan, 'Revision of European Trichoptera,' p. 164.

XL.—*On the Sense-organs of the Turbellaria.*

By Dr. L. Böhmig *.

Being engaged in investigations upon the Dendrocœlous and Rhabdocœlous Turbellaria, I wish here to communicate what I have at present ascertained with regard to their sense-organs, as the publication of my larger memoirs relating to the general structure must be delayed for some time in consequence of the accumulation of material and the preparation of figures.

A comparison of my preparations of *Planaria gonocephala*, Duj., with the figures and descriptions which J. Carrière has given † of the eyes of *Planaria polychroa* and *Dendrocœlum lacteum* has convinced me that I am able to furnish some fresh details.

The position of the eyes in *Planaria gonocephala* is the same as in all the Triclades known to me, namely in the anterior extremity of the body, described as the head. *Planaria gonocephala* has a triangular head, and the eyes lie in its middle. The longitudinal diameter of the eyes amounts to about 0·18 millim., that of the width and height about 0·1 millim. Sections through the eye allow us to recognize what follows.

Each eye consists of a pigment-capsule and a nervous apparatus; the pigment-capsule, the greater diameter of which is parallel to the longitudinal axis of the animal, consists of small blackish-brown spherules. The convex side of the capsule is surrounded by a narrow border of finely granular plasma, in which a number of distinct round nuclei are to be perceived. The great number of nuclei indicates that the pigment-capsule has originated from several cells, in opposition to the eyes of the Polyclades, in which only one nucleus occurs in this plasmatic border.

Before the opening of the pigment-capsule is the so-called *ganglion opticum*, which consists of a central ball of dotted substance, around which peripheral ganglion-cells (retinal cells) are grouped. The central nervous system is in connexion with the ball of dotted substance through the *nervus opticus*. This originates from a part of the cerebrum where the dotted substance is characterized by greater fineness and a more homogeneous appearance. The same thing occurs in

* Translated from the 'Zoologischer Anzeiger,' no. 260, 12th September, 1887, pp. 484–488.

† J. Carrière, "Die Augen von *Planaria polychroa*, O. Schm., und *Polycelis nigra*, Ehrb.," in Archiv für microsc. Anat. Bd. xx. Heft 2; and "Die Sehorgane der Thiere."

many Gasteropoda, e. g. *Helix pomatia*, in which also the part of the dotted substance from which the sense-nerves and, indeed, especially the *nervus opticus* are given off is distinguished from the rest by the above-mentioned properties.

The cells of the *ganglion opticum* possess a large nucleus, which is surrounded by only a narrow plasmatic border. They are unipolar, but this process divides immediately into a number of smaller ones, which, so far as I could ascertain, all but one enter into the dotted substance, probably to unite here with each other and with the fibres of the *nervus opticus*. One of the fibres produced by the division of a cell-process turns, however, towards the aperture of the pigment-capsule, and before entering it undergoes a more or less strong geniculation. In the cavity of the pigment-capsule it swells into the so-called terminal club. These terminal clubs completely fill up the pigment-capsule. Hitherto they have been described as hyaline structureless formations; in *Planaria gonocephala* they present a more complex structure. The fibres in question become thickened first of all into a small pestle-like formation, which sometimes shows a fine longitudinal striation. Upon this, like a hood, is seated a crescentiform, finely granulated, terminal piece, and between the two there is intercalated a thin, hyaline, intermediate plate. In *Planaria Iheringii** I do not find the intermediate plate; in this the terminal piece enveloped the club for a certain distance.

I have been unable to detect any lenses or lentiform structures. I suppose that the function of the lens is performed by the parenchymatous tissue situated between the retina and the epithelium, which during life is viscous and transparent. I regard as the retina the *ganglion opticum* and the terminal clubs, as has already been done by others.

Among the Rhabdocœlous Turbellaria I have hitherto particularly devoted my attention to the Alloiocœla. Among these the Plagiostomidæ, when compared with the Monotidæ, possess the more complex eyes, and of these two or four.

Vorticeros auriculatum possesses two eyes which are placed in direct contact with the brain, as indeed is the case in all other forms. The pigment of the pigment-capsule is, in the Plagiostomidæ, very frequently connected by pigment-cords with the pigment of the body, so also in *Vorticeros auriculatum*. The aperture of the pigment-capsule is turned

* *Planaria Iheringii*, a new Tricladous Turbellarian from Brazil, described by the author in the same number of the 'Zoologischer Anzeiger.'

towards one side; its larger axis is placed perpendicularly to the long axis of the body.

The pigment-capsule of each eye is divided by a median pigmental septum into an anterior and a posterior chamber. I have been unable to detect any plasmatic border with nuclei around the pigment-capsule; nevertheless it does not follow that it is really deficient. The pigmental septum of course causes the pigment-capsule to possess two apertures, each of which is closed by a lentiform cell with a distinct nucleus and nucleolus which lies upon it. This cell, however, is not placed close to the margin of the capsule, but leaves a small space free. The cavity of each half of the pigment-capsule is occupied by fine bacilli which stand perpendicularly to the long axis of the capsule. They leave a small central canal free, in which, in certain preparations, I observed extremely fine fibrils. Between the bacilli there is a delicate homogeneous intermediate substance. In the vicinity, especially at the margin of the capsule, there are numerous small cells which are very similar to the ganglion-cells of the cerebrum, and are only distinguished from them by a small difference in size. They possess fine processes, of which I assume that they unite with the bacilli; but this I have not seen. These cells would then have to be regarded as retinal cells.

Enterostoma striatum possesses four eyes, two small anterior and two larger hinder ones. They all lie upon the cerebrum, which, in contrast to all other Alloiocœla examined by me, is cut off from the surrounding tissues by a very sharp fine outline. *Enterostoma striatum* presents many peculiarities: thus, for example, it possesses an unpaired, dorsally-placed ovary. In the reniform pigment-capsule two globular pale structures lie close together, and these in very well-preserved specimens show a distinct longitudinal striation. This striation is due to exceedingly delicate bacilli, which are enclosed in a delicate intermediate substance. In front of the aperture of the pigment-capsule I see here two large cells which produce a closure similar to that of the lentiform cells of *Vorticeros auriculatum*. Small cells, on which I could here and there detect fine processes, lie before and in the vicinity of the large ones. The small cells stain, especially with osmium-carmine, much more strongly than the large ones, and also more intensely than the ganglion-cells of the cerebrum. In one case I was able to trace such a fine process into the neighbourhood of the striated globular structures. I regard them therefore in this case also as retinal cells. The larger pale cells, both in *Vorticeros auriculatum* and in *Enterostoma striatum*, may, perhaps, be regarded as lens-cells, as it

is certainly possible that they really act as refractive media, or at any rate are homologous in their origin with the lenses of other eyes of Rhabdocœla.

The eyes of *Plagiostoma ochroleucum*, *maculatum*, *reticulatum*, and *sulphureum* agree essentially in their structure with the eyes of *Enterostoma striatum*. Smaller differences, of course, exist, and more will probably be found on further investigation. Thus, for example, the contents of the pigment-capsule in *Plagiostoma ochroleucum* do not consist of two globular structures, as in *Enterostoma striatum*, but only of one. The tendency to break up into several pieces in the eyes of *Plagiostoma sulphureum* is also known.

I must, however, specially notice the eyes of *Plagiostoma Girardi*. In this animal the contents of the pigment-capsule consist of two clearly distinguishable substances. The larger posterior portion of the capsule is filled with a perfectly homogeneous substance which only becomes faintly coloured by reagents. In front of this there is a narrow band which does not stain at all, but shows a distinct horizontal striation. The limit of this band is very sharp and distinct both inwardly and outwardly. Before the pigment-capsule there is an aggregation of cells, of which the central ones are larger than the peripheral. They also show a difference in their behaviour towards colouring materials, the smaller cells stain more strongly than the large central ones. The figure given by von Graff, in his monograph of the Turbellaria, of the eyes of *Plagiostoma Girardi* does not agree with my representation. In my opinion von Graff had before him indifferently preserved specimens, and crushed preparations in this case only too readily give rise to illusions. What von Graff describes as the lens is undoubtedly the contents of the pigment-capsule shrivelled during preparation, and which I regard as the terminal nervous apparatus, I believe, with some justice.

A. Lang * and I. Iijima † mention in the *Planariæ* examined by them a nervous plexus, which is readily demonstrable, especially at the back of the animal. In *Planaria gonocephala*, also, there is both at the dorsal and at the ventral surface a subcutaneous nervous plexus, which may be particularly demonstrated in the cephalic part, and here again very distinctly in the auricular processes. In connexion with this subcutaneous nervous plexus I have observed in the auricular processes an apparatus which is probably to be interpreted as a terminal nervous apparatus.

* Das Nervensystem der Tricladen.

† Untersuchungen über den Bau und die Entwicklungsgeschichte der Süsswasser-Dendrocœlen.

On the dorsal surface of the auricles there is a pit about 0·03 millim. deep, and 0·025 millim. in length and breadth, diminishing downwards, which is cut off from its surroundings by a sharp and fine contour. At the bottom of the pit numerous nervous fibres enter from the subcutaneous nervous plexus, and these run to a reniform body which occupies the middle third of the depression. This body is of fibrous structure, and the fibres composing it are apparently confusedly intermixed. With picrocarmine it stains yellowish red, and much more intensely than the dotted substance which otherwise resembles it in appearance. From the free surface of this body arise a number of setæ, about 0·025 millim. in length and 0·002 millim. in thickness, which project beyond the cilia of the surrounding epithelial cells. At their free extremities these filaments are furnished with small knobs. The inferior third of the pit is only partially filled by the entering nerve-fibres; the rest is occupied by a large cell about 0·008 millim. in diameter, possessing a distinct nucleus which only stains faintly. As to the function pertaining to this organ I am quite in the dark; it is perhaps a tactile organ.

Hitherto I have been unable to find any other terminal apparatus of the nerves either in Triclades or in Rhabdocœla, with the exception of the tactile apparatus at the anterior extremity of the body in *Graffilla muricicola*, already described by me in detail; nevertheless I have often been able to trace the nerves as far as the epithelium. The only other things that I might mention are the small pale pencils which I have found among the epithelial cells of the auricular processes in *Planaria gonocephala*, and which are perhaps connected with nerve-fibres.

XLI.—*Notes on Batrachians from Perak.*

By Dr. A. Günther, F.R.S.

[Plate XVI.]

Mr. L. Wray, Jun., of the Perak Museum has again forwarded to the British Museum a small collection of Batrachians which supplies some additional information for our knowledge of the Reptilian fauna of the interior of the Malayan Peninsula. I beg to offer the following notes on some of the species sent.

Rana macrodon, Kuhl.

Mr. Wray found this species on the hills of Larut, between 3000 and 4000 feet. In the adult female specimen which he sent the tarsal fold of the skin, which is generally found in this species, is wanting. Its occasional absence may also be observed, though rarely, in *Rana tigrina*.

Phrynella pulchra, Blgr.
(Pl. XVI. fig. B.)

This toad was described and figured in this journal (1887, vol. xix. p. 346, pl. x. fig. 2) from two specimens obtained in the district of the town of Malacca. Mr. Wray has now sent a third specimen from an altitude of about 3000 feet on the hills of Perak which differs so much in coloration and general appearance from the types that I had some difficulty in recognizing it. But on perusing the notes sent by Mr. Wray with the specimen I have come to the conclusion that it must be referred to the same species.

The specimen is a male; its colour is now almost uniform purplish black above and below, only more or less indistinct traces of the ornamental markings being visible; thus especially the whitish and subtriangular mark above the vent and a spot of similar colour on the heel. Of the lower parts the throat is the darkest, the remainder being finely marbled with brown and grey.

The extremity of the snout is more pointed and less square than in the figure quoted, the nostrils being closer together.

The limbs, especially the toes, are shorter, and the disks of the fingers and also the toes broader.

Very singular is the development of the subarticular tubercles of the fingers (see fig. B). The proximal portion of the fingers is stout and the tubercles are dilated into large, soft, transverse pads, two on each of the outer fingers and a single one on each of the two inner ones. On the outer fingers the pads of each pair are close together, the anterior fitting into a hollow of the posterior.

The tongue is not entire as stated in the original generic diagnosis, but heart-shaped, being distinctly notched behind. I should describe the diapophyses of the sacral vertebra as much dilated.

Mr. Wray writes about this specimen as follows :—

"Above dark olive-brown; from the eye an oblique yellow line to angle of mouth; a pale olive-yellow mark across forehead, through the eyes, and down the sides of the body to the

thighs. This band is minutely spotted with dark brown principally along the centre. There is also a triangular dark-centred mark of the same colour on the anal region, extending to the top back surface of the thighs. The legs and arms banded in the same way.

"Beneath, throat dark brown, passing into yellowish on breast; abdomen hair-brown, minutely spotted with whity brown. Legs and arms, palms of hands and feet the same. Irides red-brown, diamond-shaped, horizontal. The colour and form of markings are subject to considerable variation, and the intensity of colour is in a great measure subject apparently to the will of the animal. It may range from dark to pale brown. I have not been able to find out why they change colour; they do not seem to change when frightened, nor does the colour of the surface on which they rest have any effect on them, but when in the dark they are usually light-coloured, and when in the light dark-coloured.

"They inhabit the hills of Perak from 3000 feet upwards, and live in holes in trees which are so situated as to contain more or less rain-water. They have a loud, flute-like, musical note, which they utter at irregular intervals, principally during the night. The form and size of the hole in which they are seems to have a great deal to do with the loudness of the note, as specimens when extracted from their holes have far more feeble vocal powers than they had when in them. The pitch of the note is also much altered by the resonant properties of the cavity. These frogs blow themselves out with air, and look more like bladders than anything else. When inflated they float on the surface of the water, and will remain motionless for a long time with legs and arms stretched out."

Bufo quadriporcatus, Blgr.
(Pl. XVI. fig. C.)

This species was described and figured from a single and not very well-preserved specimen, apparently a male, in this journal, vol. xix. p. 347, pl. x. fig. 4 (1887). Mr. Wray has sent a female specimen in a better state of preservation. The whole of the surface is densely covered with larger and smaller conical or semiglobular tubercles, the larger tubercles being placed in a series continuous with the parotoid, and in an irregular row along each side of the vertebral line, also the eyelids and the head between the eyes are covered with small tubercles. Two metatarsal tubercles of moderate size. There is no tarsal fold of the skin, but its place is occupied by a row of four horny conical tubercles, each with an acute black

point. Upper parts brownish, marbled with olive, some of the large tubercles surrounded by a black ring; parotoids and the tubercles of the series behind it whitish, more or less distinctly edged with black; limbs irregularly barred, lower parts white, marbled with brown, especially across the stomach.

Mr. Wray says that this species is rare, he having obtained two specimens only, and that it inhabits the hills of Perak from 800 feet downwards.

Polypedates leprosus, sp. n. (?).
(Pl. XVI. figs. A, *a*, *a'*.)

Habit hyliform, with very large and broad head. Vomerine teeth rudimentary, on a short linear ridge, the ridge on each side being close to the choana. No conical papilla on the middle of the tongue. Snout very broad, with the canthus rostralis angular, and the loreal region sloping; nostril lateral, but close to the tip of the snout. Interorbital space wider than the upper eyelid. Tympanum distinct, not quite as wide as the eye. Fingers quite free; toes broadly webbed; disks of fingers and toes large, the largest being at least half the size of the tympanum; subarticular tubercles well developed, inner metatarsal tubercle ovoid. The tibio-tarsal articulation reaches the extremity of the snout, when the hind limb is drawn forward along the side of the body. All the upper and lateral parts are covered with rough tubercles, between which numerous very large ones like glands are scattered over the back, the upperside of the head, and the upper parts of the limbs; also a part of the tympanum shows some minute granules. The whole frog is bluish black in spirit; but some of the large tubercles are of a lighter colour, either entirely, or only the roughnesses with which they are covered are whitish; lower parts coarsely granular, with vermiculated whitish lines.

Distance between snout and vent 30 lines; distance between the angles of the mouth 11 lines; distance between the vent and extremity of fourth toe 49 lines.

Mr. Wray gives the following notes:—"Above rich warm chocolate-brown. The tops of the warts paler, some of those on the back yellow. Beneath—body, legs, and arms jet-black, irregularly marked with pale bluish grey. Under surface of fingers and toes bright rose-red. Web to feet and top surface of all the disks same colour. Irides pale warm brown, pencilled radially with black, a fine yellowish-orange line forming inner edge to irides.

"Pupil diamond-shaped, horizontal.

"The colour and rugose character of the skin of this frog is evidently a means of protecting it from birds and other enemies, the whole upper surface being such a close copy of the bark of a tree that it is very hard to detect one when resting upon it.

"This species also lives in holes in trees, and the note produced by it is not so loud as that of *Phrynella*, and has a more metallic ring in it.

"My specimens were obtained at an elevation of 4000 ft. on the hills of Larut, Perak."

Mr. Boulenger has directed my attention to the fact that this species resembles closely a frog from Padang, shortly noticed and rudely figured under the name of *Hyla leprosa* by Schlegel, in a popular work, 'Handb. der Dierk.' ii. p. 55, pl. iv. fig. 68. Tschudi considered it the type of a distinct genus, *Theloderma* (Class. Batr. 1839, pp. 32, 73); and more recently it was more fully described by Horst (Notes Leid. Mus. v. p. 237). The two latter authors agree in ascribing to the frog a tongue cordate behind, but terminating in a single appendage. If this form of tongue is really characteristic of the Padang frog, the latter would have to be referred to a genus distinct from *Polypedates*; but if it be merely caused by some accident, our specimen may prove to be identical with that in the Leyden Museum. In either case the creation of a synonym will be avoided by adopting here the same specific name.

Megalophrys longipes, Blgr.

Megalophrys longipes, Blgr. Proc. Zool. Soc. 1885, p. 850, pl. lv.

This species is rare and local, Mr. Wray having succeeded in obtaining three specimens only, of which one was captured at an elevation of 4400 feet.

MISCELLANEOUS.

Observation on Multiplication in Amœbæ. By Lillie E. Holman.

On the 4th of July, 1886, I was examining the forms of life contained in a Holman life-slide which had been filled for several hours. It contained different Infusoria, and, among other animals, specimens of *Æolosoma*. But it seemed for some time as if there were no *Amœbæ* in the slide, until I discovered a small one near the channel. In shape it seemed like an elongated triangle, and was rather torpid, or, at least, moved but little. While I was examining it, it moved up closer to the line of the channel, and another *Amœba*, about twice the size of the first one, came gliding on the scene. It moved up very close to the other, and in a few

moments I noticed that it looked as if it were trying to swallow the smaller *Amœba* in the same manner that it does its ordinary prey. As I had watched many *Amœbæ*, and had never seen anything like this, and as I knew that they did not prey on each other, and the question of their conjugation was a very doubtful one, I dismissed the idea of the larger absorbing the smaller, and concluded it was merely the fact that they were in too tight a place to allow of their passing each other which gave them this appearance. I watched them constantly for about half an hour, in the course of which time I became convinced that something unusual was going on.

The larger *Amœba* had entirely surrounded the smaller one, which, however, did not seem to lose its vitality. First it seemed to be under the endosarc of the larger, and then above it. Sometimes it would project a pseudopod out from beyond the ectosarc of the larger animal. All the time it was distinctly visible in its own individuality, if one may so call it, and did not at all seem to be trying to escape. I called Mr. Holman's attention to the singularity of their behaviour, and expressed my belief that it was a case of either cannibalism or conjugation. He expressed his disbelief in either of these cases, and observing that the water in the slide was evaporating, we allowed a little to creep in under the closed edge of the cover-glass. This seemed to relieve the large *Amœba* from the constrained position and flat contour which it had assumed, and it immediately began to put out pseudopods and move away; and the smaller one moved off with it, evidently engulfed in the larger one, and quiescent in that position.

The small *Amœba* occupied a position in the upper part of the larger one. As this last moved on it seemed to push the small one in an opposite direction from that which its granules were taking till it reached about the centre of its body. Then it commenced an evident effort to expel the smaller one. It reached out its pseudopods in every direction, gradually expelling the smaller one, until it was completely discharged. The smaller one by this time assumed an almost spherical shape.

At last the large *Amœba* ceased moving, and began to expel refuse matter, as is common with them. It had anchored itself near some other refuse matter, probably vegetable, and really looked as if it was using it as a sort of grapple for the purpose of ridding itself of the rejected smaller *Amœba*. It was successful, for in a few moments it moved away to the upper part of the field, leaving the round ball, looking in every respect like an encysted *Amœba*, near the little group of refuse. It went on in the field, and we followed it for some time, when it became quiet, and we went back to the encysted one. I watched it to see what would happen next, for it seemed as if there must be some strange sequel to our remarkable observation; and the watching was not in vain. The flat disk began by a sort of contractile movement to throw out particles or granules, as if it were laying eggs. I can think of no other expression, although the particles, while approximate in size, had no regularity of shape. This continued till the *Amœba* again assumed its clear and transparent appearance, and at last, seeming

to fully regain its activity, put out a pseudopod and moved in the field, leaving behind it a group of the particles or granules. Only for a little while, however, did it move; in a few moments it lost its animation, seemed to become transparent, and at last faded into one of those disks which seem to be merely the shells of once active forms. I did not see it move again.

This observation was carried on continuously during two hours and a half, and every stage watched most closely. I was at a loss what to call it, if not a clear case of conjugation and separation.

The most convincing proof to my mind that this was a proceeding which was for a purpose was given when, two nights after, this slide, which was laid carefully aside for future examination, was found to be full of young *Amœbæ*. They literally swarmed; I counted in the field at one time twenty-four of uniform size, while I have no hesitation in saying that there were between one and two hundred in the slide, which had before held but two. The worn-out disk was recognized, and also what seemed to be the remains of the larger *Amœba.—Proc. Acad. Nat. Sci. Philad.*, Oct. 26, 1886, p. 346.

On the Byssal Organ of the Lamellibranchiata.

By M. Ludwig Reichel.

My researches upon the byssal organ have led me to the following results, which differ from previous statements.

From the observations of Réaumur and A. Müller it is generally regarded as proved that bivalve Mollusca which have once been attached by a byssus are thereby prevented from changing their place throughout their lives, unless they are torn away accidentally by external force. The animals can, however, temporarily regain their power of free movement, although not by tearing or separating the byssus-threads as the two naturalists referred to thought possible, but by throwing off the whole of the byssus, *i. e.* with stem and root, when the organ is replaced by a new formation. This casting of the byssus is a process exactly analogous to the change of skin in the Arthropoda. In *Dreissena polymorpha* such a change of the byssus takes place regularly at the commencement of the cold season. In summer the animals are seated close to the surface of the water, so that they are easily reached by the hand from the bank; towards the end of autumn, however, they retire into the deep water, leaving their byssus behind them.

As regards the formation of the byssus, it is almost universally regarded as the secretion of special glands. I cannot adopt this opinion, any more than that supported by von Nathusius-Königsborn, that the byssus grows forth out of the tissues of the body of the animal. The byssus rather originates as a cuticular formation, the stem with the roots in the byssal cavity and the threads in the pedal groove. Thus in those Lamellibranchiata which are provided with a byssus the underside of the foot is traversed by a rather deep longitudinal groove, which opens at the base of the foot into a cavity, the so-called byssal cavity. In the opinion of those who adopt the theory of secretion the foot and the walls of the byssal

cavity are occupied by gland-cells which discharge their secretion into the groove, *i. e.* the cavity, and furnish the material for the formation of the byssus. No such gland-cells are present, however, as I shall demonstrate more in detail in my completed memoir.

The groove which traverses the foot shows two distinct parts, an outer one of simply fissure-like form, and an inner one with a crescentic transverse section. This is quite in open connexion with the fissure, and is to be regarded merely as the sudden dilatation of the fissure towards the two sides. By the approximation of the margins of the fissure it can be closed so as to form a complete canal, which is called the crescentic canal from the form of its transverse section. It is exclusively in this part of the groove that the byssal threads originate as a cuticular formation of the epithelium which lines the canal. This is not a vibratile epithelium like that which forms the surface of the fissure, the processes which are seated upon the epithelial cells of the canal are the byssal substance formed by them, but not vibratile cilia, for which they have hitherto been taken.

Two characters accentuate the distinction between the epithelium of the canal and the vibratile epithelium of the fissure. In the latter the cilia are seated upon a cell-membrane, which in transverse section is distinctly recognizable by a double contour. In the former, however, only a simple line appears beneath the processes, and this forms the boundary between the byssal substance and the epithelial cell. Further, each of these epithelial cells in the canal has only one process, while in the vibratile epithelium a number of cilia are seated upon each cell.

As already indicated a byssus consists of a stem with its roots, and byssal threads seated upon the stem.

According to the secretion-theory, threads are produced only when the stem is partially or completely developed, and they are attached or stuck to it. Further, a different mode of production from the threads is frequently ascribed to the stem, inasmuch as it is said to be formed by gland-cells which differ from those which are contained in the foot. This notion is, however, contradicted by observation. The stem and threads of the byssus originate in the same manner, simultaneously, and in immediate connexion with each other. This indeed is quite natural, for the crescentic canal opens into the byssal cavity, passing into it gradually, so that its wall passes into that of the cavity. Now if a cuticular formation occurs it will extend over the whole surface of the cavity and the groove, and in consequence the threads originating in the canal will be united with the formation in the cavity.

The casting-off of the byssus is connected with a retrogression of the byssal cavity. This, in its normal state, is divided at the bottom by a great many perpendicular septa, standing in the longitudinal direction of the animal, into so many chambers or secondary cavities. At the casting of the byssus these septa are reduced. From the previously complicated byssal cavity is produced a simple cavity, showing only a few folds in its walls. The septa originate afresh only with the new formation of the byssus; their epithelium gives

origin to the roots of the byssus, which, in the form of lamellæ, occupy the chambers between these septa.—*Zoologischer Anzeiger*, No. 260, September 12, 1887, pp. 488–490.

Ovo-viviparous Generation in Tropidonotus.

Professor Heilprin presented the following communication, dated April 15, 1887, from Mr. H. C. Young, of the Philadelphia Custom House, referring to a water-snake shot by that gentleman some fourteen years ago, at a locality about three miles above Salem, N. J.:—

"Upon examining the snake (which was almost as thick as my forearm) I found it contained considerable of a bunch which I supposed to be something it had swallowed; but upon cutting it open I found it contained small snakes in a bag, each one in a separate division formed as it were by a twist in the bag. I took them out, and found there were thirty-three of them of different sizes, a number of the smaller ones having a portion of an egg attached to them, which they appeared to be absorbing, the larger ones having already absorbed theirs. I was then convinced that while the land-snakes lay eggs in the earth, to be hatched by the heat of the sun, the young of the water-snake are actually hatched in the belly of the mother."

Prof. Heilprin stated that the snakes had been presented by Mr. Young to the Academy, and on examination proved to be *Tropidonotus sipedon*. The case demonstrated beyond a question of doubt that the species was ovo-viviparous.—*Proc. Acad. Nat. Sci. Philad.*, April 26, 1887, p. 121.

Literature of the Fossil Ganoid, Semionotus.

By A. Smith Woodward.

The appearance of the new part of Dr. Zittel's admirable 'Handbuch der Palæontologie' has enabled me to discover Dr. Fraas's description of *Semionotus Kapffi*, for which I had long sought in vain while preparing the list of species published in the last number of the 'Annals' (p. 178). Both the description and figures will be found in the 'Württembergische Jahreshefte,' vol. xvii. (1861), p. 91, pl. i., and here are also made known two other Keuper forms, *S. elongatus* and *S. serratus*, which differ from the Brora Jurassic fossil, among other points, in the characters denoted by their respective specific names. Dr. Zittel likewise refers to some brief descriptions of Italian Jurassic species by Bellotti, in Stoppani's 'Studii geologici e paleontologici sulla Lombardia' (1859), none of which apparently agrees with the new *Semionotus Joassi*.

It may be well to point out, moreover, that in the figure of *S. Joassi* (*suprà*, Pl. VIII. fig. 1) the artist has unfortunately omitted to include some fragments of the anal fin, which indicate that this appendage originally possessed more rays than are now completely shown, thus having a longer base and extending somewhat further back towards the tail.

CONTENTS OF NUMBER 118.—*Fifth Series.*

Page

XXIX. Bryozoa from New South Wales, North Australia, &c. By Arthur Wm. Waters.—Part III. (Plate VII.) 253

XXX. Descriptions of eight new Species of Asiatic Butterflies. By H. Grose Smith 265

XXXI. Description of a new Rat from North Borneo. By Oldfield Thomas 269

XXXII. Notes on *Sphingidæ* from the Malay Peninsula, and Description of a new Species of *Ambulyx* from North Borneo. By W. L. Distant 270

XXXIII. On the Interpretation of *Polyparium ambulans*, Korotneff. By Prof. E. Ehlers 273

XXXIV. On a remarkable new Species of *Cladorhiza* obtained by H.M.S. 'Challenger.' By Arthur Dendy, B.Sc., F.L.S., Assistant in the Zoological Department of the British Museum. (Plate XV.) 279

XXXV. On the Classification of the Diplopoda. By R. Innes Pocock, Assistant Naturalist British Museum 283

XXXVI. Descriptions of new or little-known South-American Frogs of the Genera *Paludicola* and *Hyla*. By G. A. Boulenger .. 295

XXXVII. Notes from the St. Andrews Marine Laboratory (under the Fishery Board for Scotland).—No. VIII. By Prof. M'Intosh, M.D., LL.D., F.R.S., &c. 300

XXXVIII. A new Species of *Zygæna* from the Kurrachee Harbour. By James A. Murray, Vict. Nat. Hist. Inst. 304

XXXIX. Scent-organs in *Phryganidæ*. By Dr. Wilhelm Müller 305

XL. On the Sense-organs of the Turbellaria. By Dr. L. Böhmig.. 308

XLI. Notes on Batrachians from Perak. By Dr. A. Günther, F.R.S. (Plate XVI.) 312

MISCELLANEOUS.

Observation on Multiplication in *Amœbæ*. By Lillie E. Holman .. 316

On the Byssal Organ of the Lamellibranchiata. By M. Ludwig Reichel 318

Ovo-viviparous Generation in *Tropidonotus* 320

Literature of the Fossil Ganoid, *Semionotus*. By A. Smith Woodward *ib.*

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No. 119. NOVEMBER 1887.

XLII.—*The True Nature of the "Madreporic System" of Echinodermata, with Remarks on Nephridia.* By Prof. Marcus M. Hartog, D.Sc., M.A., F.R.U.I.*

Sharpey, in his article on "Echinodermata" in Todd and Bowman's 'Cyclopædia of Anatomy and Physiology,' writes: "If the liquid contained in the feet of the starfish be sea-water, either pure or with an admixture of organic particles, which is probable from its chemical composition, may it not be introduced and perhaps again discharged through the pores of the disk [*sc.* madreporite] and the calcareous tube, the porous disk serving as a sort of filter to exclude impurities?" He also describes the perivisceral liquid as a "clear fluid which, when filtered, yields no trace of animal matter, but agrees almost entirely in composition with sea-water."

These observations, apparently unchecked by subsequent experiment, seem to have been the origin of the widely adopted views that the cavities of Echinodermata are filled with sea-water directly taken up *pro re natâ* through the madreporite and madreporic canal, which for brevity we may

* This paper was read in a less complete form at the British Association, Manchester, 1887.

term the "madreporic system." Claus, Gegenbaur, and Huxley are all agreed on this point in their text-books. Having had my attention early directed to similar statements about the organ of Bojanus, and having been the first to demonstrate * that this latter organ could not possibly take up water, owing to the outward ciliary wash and the valvular orifice, I was naturally inclined to doubt the received views on the madreporite; and latterly reflection on certain facts in vegetable physiology induced me to inquire more fully into the matter.

The vegetable cell, containing in its cavities dissolved substances of high osmotic equivalent, and bounded by protoplasm permeable to water but not to these substances, tends to take up into its cavities an excess of water, limited by various conditions which we need not discuss here; and thus the cell becomes *turgescent*, or *erect* as the animal physiologist would say. The animal body, with its system of cavities and partially permeable walls, is in precisely the same condition as the vegetable cell; and if erection, turgescence, or dropsy do not occur when the body is immersed in liquid (or air saturated with moisture), it is because of the existence of a variously disposed apparatus through which the excess of liquid is ejected, carrying off in solution various soluble waste products. Such an apparatus is termed a *nephridium* or *kidney*.

We can see in Infusoria that when the contractile vacuole fails to act with its habitual regularity under certain abnormal conditions, the animal becomes dropsical, swells up, and finally bursts. In higher animals we find either ciliated funnels or special filter-pumps, or both, acting to remove the excess of liquid. If an erection in any part of an animal be needed, the liquid can be supplied either by the excess of endosmose over excretion, or by the flow of liquid from one part to another.

To these physiological considerations are added morphological ones of great significance. The accumulation of liquid takes place into the cœlom, in Annelids and Vertebrata *a mesothelial sac of which the first part of the nephridium is a diverticulum*, to which an *invaginated epiblastic duct* is added. The whole ambulacral canal-system of Echinodermata is a development of such a *diverticulum of a mesothelial cavity*, and the madreporic system is in great part at least an *epiblastic invagination*. In the Echinopædium we must needs regard the madreporic system and the "vasal" part of

* 'Journal of Anatomy and Physiology,' 1879.

the left vasoperitoneal sac as constituting a left nephridium, the right having failed to receive a duct *. Of the numerous madreporic systems of some Holothurians I believe the development has not been made out. If the madreporic system be really of nephric nature it would seem *à priori* unlikely that the ciliary action should be reversed, despite the acquirement of other functions by the nephridium itself. These considerations determined the following experiments, which fully bear out the views which I have expressed.

Exp. I.—A fresh strong *Echinus sphæra* was opened and the madreporic canal dissected out and cut off at either end, and then a longitudinal slit was made in one side; on examining it in the perivisceral liquid I could easily see a strong inrush of particles through the slit and a corresponding outrush through the cut distal end of the tube, *i. e.* that turned towards the madreporite. This was repeated and confirmed on six specimens. The stony canal of *Asterias* was found unsuitable for similar experiments.

Exp. II.—From a live *Echinus* I cut out the madreporite with a short stump of duct attached, and examined it in sea-water to which a little charcoal powder was added. The disk lived for over sixteen hours with active ciliary currents and movements of the spines and pedicellariæ. The flakes of charcoal were carried about in the currents, but *never reached the surface of the disk* except close around the bases of the spines, where there are no perforations. They seemed repelled from it, instead of settling down by gravitation; and this could only be due to an outward current through the pores.

Exp. III.—I excised the madreporite of a live Starfish with a short stump of the sand-canal, and examined it in the perivisceral liquid of *Echinus* to which a little carmine was added, the cœlomic surface of course downwards. Examination was here possible by strong transmitted light (the full aperture of the Abbe condenser) as well as by reflected light. The surface is marked by radiating ridges (imperforate), and if there were any indraught the carmine particles should be *attracted* towards the centre of the disk and the bottom of the grooves; if there were merely no outrush they

* It is interesting to recall the development of the nephridium in *Peripatus*:—"The ventral half of each somite remains distinct, and consists of a small vesicle, leading from which is a small coiled tube (nephridium) which acquires an external opening" (Haddon's summary after Sedgwick, Embryology,' p. 59). This is comparable to the division of the vasoperitoneal sac into two in Echinodermata, the inferior (*sc.* ventral) portion going to form the ambulacral system.

should *gravitate* towards the bottom of the grooves. But this did not occur; on the contrary, the carmine settled round the edge of the disk; and in one or two places *on the ridges*, where, from their convergence, an eddy must necessarily exist: not a particle entered the grooves. Three madreporites were examined, all with the same results, even after three hours.

Exp. IV.—A Comatula (*Antedon rosaceus*) was examined disk upwards in sea-water with charcoal powder, the arms being removed to facilitate observation. During three hours no charcoal particles reached the surface of the disk, except along the *imperforate* ambulacral grooves; on the contrary, as they floated down towards the disk they seemed arrested above its surface by an invisible screen, which could have been only due to an outward current through the cœlomic pores.

Exp. V.—The same observations on *eviscerated disks* of Comatula gave the same results.

The above experiments show clearly that the perforations of the madreporite in *Echinus* and *Asterias*, and of the disk in Comatula, are purely excretory, and serve to eliminate the excess of water taken up by the body.

It may now be urged, "How, then, can the Echinoderm take up the liquid that fills its perivisceral and ambulacral cavities?" One might as well ask how a Vertebrate takes up the liquid in its cœlom, blood-vessels, and bladder. The answer is by *osmosis*, through the walls of the gut (respiratory siphon especially), the tube-feet, and the "gills." It will easily be seen that when a starfish protrudes its tube-feet rapidly the arm becomes limp from the evacuation of the ampullæ, and when it retracts them the arm regains its turgidity, owing to the refilling of the ampullæ. In *Echinus* the problem appears complicated by the close rigid shell, which would seem to prevent any ingress and egress of liquid from its cavity; but, in the first place, the soft peristome is protractile and retractile, and quite large enough to balance by its movements very considerable alterations in the capacity of the ampullæ; and in the next place the intestine, through which water is constantly streaming, is also dilatable.

In the majority of the Holothuria we find that the madreporite has lost its connexion with the surface, and opens into the cœlom. This admits of a ready explanation. The cloaca is rhythmically contractile, and receives the excess of the cœlomic liquid by what are physiologically nephrostomes attached to the respiratory trees, an arrangement physiologically the same as the nephridial apparatus of Rotifera. Théel

has shown that in some Elasipoda which have no respiratory trees, the madreporite has retained its primitive position at the surface. A curious converse transformation may be noted in Amphibia, and seems to shed light on the matter. In the aquatic tadpole there are numerous nephrostomes opening into the kidney, and so on to the exterior. In the adult Anuran, living mostly on land, and consequently absorbing less water by osmosis, the nephrostomes have lost their connexion with the kidney and open into the veins.

I have quoted Sharpey's observation as to the nature of the cœlomic liquid, exaggerated by most zoologists into a statement that it was pure sea-water, till P. Geddes rediscovered the corpuscles ("organic particles" of Sharpey). On filtering the cœlomic liquid of *Echinus* clear from the clot and boiling it down I obtained a flaky coagulum, which gave Millon's reaction perfectly and which must be due to a dissolved proteid, only coagulable on boiling, and distinct from the formed elements which compose the spontaneous coagulum.

To summarize:

1. The madreporic system of Echinodermata is morphologically and ontogenetically a (left) nephridium.
2. Its ciliary current is directed outward through the madreporic disk, and an outward current takes place through the pores of the disk of Comatula.
3. There is no need for the taking up of sea-water by a perforated plate, since osmosis is amply sufficient for the turgescence of dilatable organs.
4. The *rapid* contraction or erection of the tube-feet is due to the transference of liquid from one part to another; in Echinoidea this may be balanced by the protrusion or retraction of the peristome, or by contraction or dilatation of the gut, or in both these ways.
5. The change of position of the madreporite in most Holothuria is probably due to the usurpation of nephridial functions by the respiratory trees attached to the cloaca.
6. The cœlomic liquid of *Echinus* contains, besides corpuscles, a dissolved albuminoid, coagulated on boiling.

I take this opportunity of adding two notes on cognate subjects.

Note I.—I think it very probable that when an Actinian is at rest the lips of the oral slit are closely appressed, and, in

fact, hermetically sealed. The turgescence of the body would then take place by osmosis, and the apical pores of the tentacles would have the double function (*a*) of the periodical or perhaps constant discharge in small quantities of the excess of liquid, (*b*) of its rapid discharge when, in defence, the animal wishes rapidly to reduce its bulk.

Note II.—The nephrostomes of Rotifers and many other lower Vermes are described as having a single long flagellum working inside them. Now from the same optical reasons that make it impossible to conclude from the mere microscopic picture what is the true structure of striated muscle or the markings of a Diatom, it is equally impossible to conclude what is the true structure of these "flame-like" nephrostomes. A lining of fine vibratile cilia would leave an undulating lumen that would be optically identical with the supposed single flagellum. The precise attachments and working of such a flagellum form a problem that no one has attempted to tackle; whereas the view that there is a lining of fine cilia offers no such difficulties; and this view is hence the more plausible. It has, moreover, the advantage of completely homologizing these structures with the nephridia of their more highly organized allies.

XLIII.—*The New System of* Chalininæ, *with some Brief Observations upon Zoological Nomenclature.*

By Arthur Dendy, B.Sc., F.L.S., Assistant in the Zoological Department of the British Museum.

Through the kindness of my friend Dr. R. von Lendenfeld, F.L.S., I have lately received a copy of a recent paper by him on the Australian Chalininæ *. For several reasons this important memoir, consisting of no less than 105 pages and illustrated by ten beautiful plates, seems to me to deserve special comment in this place.

The paper is founded mainly on the large collection of Chalinine sponges made by the author during his residence in Australia; and he has also had access to the collection in the British Museum. We are informed that the author's own

* "Die Chalineen des australischen Gebietes." Von Dr. R. v. Lendenfeld. Separatabdruck aus den Zoologischen Jahrbüchern. Zweiter Band, 1887.

collection, which is now in the possession of the British Museum, includes 153 species (and varieties), of which 131 are new, and that the number of known Chalininæ is thereby increased from 96 to 227. The author possessed good spirit-material of 54 species, so that he was enabled to study carefully the structure of individual representatives of the different groups. Under these circumstances he has found it necessary to create a new system of Chalininæ.

The main body of the paper is divided into four sections:—"I. Morphologie der Chalinidæ; II. Das System der Chalininæ; III. Die geographische Verbreitung der Chalinidæ; IV. Die australischen Chalininæ."

I. *The Morphology of the* Chalininæ.

I naturally consider the morphological section to be of the greatest general interest, and I can but wish that it were a little longer. One or two statements call for special remark.

On page 726 we find the sentence "Es ist keine incrustirende Chalinide bekannt." In view of the facts of the case this seems to be a rather hasty generalization. In our Preliminary Report on the Monaxonida of the 'Challenger' Expedition, published in this journal in 1886, Mr. Ridley and I have described an incrusting species of *Chalina* under the name *Chalina rectangularis*, and our specific diagnosis commences with the words "Incrusting, thin, with low mound-like prominences, each bearing a vent" *. Dr. von Lendenfeld, however, surmounts this difficulty in rather a novel fashion, namely by placing *Chalina rectangularis*, Ridley and Dendy, in a genus of his own, *Dactylochalina*, which he characterizes as "dickfingrig" (!), wherein our incrusting *Chalina* appears under the name "*Dactylochalina rectangularis* Lendenfeld." But there is another difficulty which is not so easily got over, and that is that the author himself describes on p. 823 of the work under consideration a new species under the name "*Hoplochalina incrustans* n. sp.," the diagnosis of which commences with the words "Klein, incrustirend, 4 mm. hoch"!

Any detailed information with regard to the canal-system of the Chalininæ is, of course, of the highest importance, and it is disappointing to find that the section of the paper devoted to this subject is very brief. It will be best to give the gist of the author's conclusions on this head in his own words:—"Das Canalsystem der Chalineen ist sehr einfach.

* Ann. & Mag. Nat. Hist. ser. 5, vol. xviii. p. 331.

Die Poren führen in mässig ausgedehnte Subdermalräume. . . . . Die von dem Subdermalraumboden entspringenden, einführenden Canäle sind ziemlich weit und entbehren jeglicher Klappenvorrichtung. Besonders auffallend ist die sehr beträchtliche Weite der letzten Verzweigungen derselben, welche in einzelnen Fällen fast so weit wie die Stämme selbst sind. Sie übertreffen den Durchmesser der Geisselkammern in vielen Fällen. Ihr Durchmesser sinkt nicht unter 0·02 mm. herab.

"Die Geisselkammern sind kugelig und besitzen eine kleine Ausströmungsöffnung, deren Durchmesser ein Viertel oder weniger von jenem der Kammer besitzt. Der Durchmesser der Kammern schwankt zwischen 0·02 und 0·04 mm. Die kleineren Kammern sind vorherrschend. . . . .

"Die ausführenden Canäle sind ungefähr ebenso weit wie die zuführenden und entbehren, wie diese, der Klappenvorrichtungen. Am Pseudosculum der röhrenförmigen Formen wird selten, namentlich bei einigen *Phylosiphonia*-Arten, ein ringförmiger Sphincter beobachtet, der durch ein specielles Skelet gestützt sein kann. . . . .

"Es geht hieraus hervor, dass das Canalsystem der zu der Gruppe Chalininæ vereinten Formen ziemlich unveränderlich ist, und es leistet diese Monotonie desselben in gewissem Grade Bürgschaft für die Solidarität der hier zur Subfamilie der Chalininæ vereinten Spongien."

This brief account is supplemented by some very remarkable figures, which, however, are of doubtful assistance in clearing up the question as to the nature of the canal-system. In these figures (plate xxvii. figs. 14, 16), taken from two species (*Phylosiphonia superba*, Lendenfeld, and *Cladochalina mollis*, Lendenfeld), the flagellated chambers are figured, not as opening direct into the wide exhalant canals, as would seem to be implied, though not explicitly stated, in the letterpress, but through the intermediation of very remarkable, funnel-shaped canaliculi. If these canaliculi really exist, it is, of course, a very important fact, and it is indeed strange that no mention of them should be made either in the section on the canal-system or in the description of the plate. Either we must suppose that the figures are of that more or less imaginative character which has unfortunately been so prevalent in works on sponges, or that the account of the canal-system is imperfect.

Judging from my own researches on the canal-system of *Pachychalina spinosissima*, I am inclined to accept the former hypothesis, and to doubt the existence of the funnel-shaped canaliculi. In *Pachychalina spinosissima* I have lately figured

and described* the exhalant canal-system as being typically eurypylous, the flagellated chambers opening directly by means of *wide* mouths into the wide exhalant lacunæ, a condition about the existence of which in that species there cannot be the slightest doubt, and which is thoroughly in harmony with Dr. von Lendenfeld's and my own published opinions regarding the close relationship of the Chalininæ to the Renierinæ. If, however, Dr. von Lendenfeld's figures are correct, then we have two types of canal-system to deal with in the group Chalininæ, and his statement "Es geht hieraus hervor, dass das Canalsystem der zu der Gruppe Chalininæ vereinten Formen ziemlich unveränderlich ist, und es leistet diese Monotonie desselben in gewissem Grade Bürgschaft für die Solidarität der hier zur Subfamilie der Chalininæ vereinten Spongien," would seem to fall to the ground.

The comparative length of the section on the spicules of the group is due to the fact that Dr. von Lendenfeld includes amongst his Chalininæ a number of species possessed of other than oxeote megasclera, and also certain species which even have microsclera, a proceeding which, in my opinion, is quite unjustifiable. But I shall return to this question later on, and have only to remark, with regard to the spicules described and figured, that *Gelliodes poculum*, Ridley and Dendy, has certainly not got any sigmata of the very remarkable shape figured as belonging to that species (plate xxvii. fig. 9).

The author's discoveries with regard to the nervous system of the Chalininæ are most important and worthy of the most careful attention. He finds that the nervous system consists of irregular cells, distributed in the neighbourhood of the pores. These always remain single, and there are usually from three to five to each pore. They appear to be ganglion-cells, and each one gives off a process which projects beyond the margin of the pore as a distinct "thorn" into its lumen (plate xxvii. fig. 15). Future investigators will do well to endeavour to confirm these very remarkable and important results.

It is also very interesting to learn that the Chalininæ possess spongoblasts like those of the true horny sponges—a fact which was before almost certain from analogy, but which it is most important to have confirmed by direct observation.

The embryological section calls for no special comment, and this part of the subject is left pretty much in *statu quo*.

* Proc. Zool. Soc. 1887, p. 524, woodcut, fig. 6.

II. *The Systematic Position and Classification of the* Chalininæ.

In dealing with this portion of our subject it is necessary in the first place to endeavour to decide the all-important question "What is a Chalinine sponge?"

In our Preliminary Report* on the 'Challenger' Monaxonida Mr. Ridley and I have divided the suborder Halichondrina (Vosmaer) (excluding the Spongillidæ) into the following four families:—(1) Homorrhaphidæ, (2) Heterorrhaphidæ, (3) Desmacidonidæ, (4) Axinellidæ.

The Homorrhaphidæ are characterized by the fact that the megasclera are all diactinal, either oxea or strongyla, and there are no microsclera. They are divided into two subfamilies—(1) the Renierinæ, in which the spicules may be united together by a small proportion of spongin, but are never completely enveloped in it; and (2) the Chalininæ †, in which a considerable amount of spongin is present, typically forming a thick sheath, completely enveloping the spicules and uniting them into strong fibres.

According to this arrangement, then, *a Chalinine sponge is a Halichondrine with diactinal megasclera (skeleton-spicules) and no microsclera (flesh-spicules), and with a large amount of spongin uniting the spicules into strong fibres.*

Since the publication of our Preliminary Report I have had occasion to pay very considerable attention to this group of sponges, and have not yet seen any reason to alter our original view.

Dr. von Lendenfeld appears, however, to think differently upon this subject, and of course every man has a perfect right to his own opinion. Strange to say, however, in the paper under discussion he gives the following scheme of classification (p. 761):—

"Subordo Halichondrina.

1. Fam. *Spongillidæ.* Mit Gemmulæ,

2. Fam. *Homorrhaphidæ.* Ohne Gemmulæ und ohne differente Fleischnadeln,

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* In this and other cases I refer to our Preliminary Report rather than to our complete Report, because at the time when Dr. von Lendenfeld wrote his paper the latter was not published.

† By an oversight these names appear as "*Renierina*" and "*Chalinina*" in our Preliminary Report; this oversight is rectified in the full Report.

3. Fam. *Heterorrhaphidæ*. Ohne Gemmulæ mit differenten Fleischnadeln ohne Anker,

4. Fam. *Desmacidonidæ* *. Ohne Gemmulæ, Fleischnadeln, Anker.

Familia *Homorrhaphidæ*.

1. Subf. *Renierinæ*. Nadeln nicht vollständig von Spongin umschlossen.

2. Subf. *Chalininæ*. Das Skelet besteht aus einem Sponginfasernetz mit eingelagerten Nadeln."

In this classification the Axinellidæ appear to be altogether left out of account. Yet, in spite of this omission, it bears a very striking resemblance to that published by Mr. Ridley and myself, as given above. In fact Dr. von Lendenfeld appears to have adopted our classification in the main, but instead of giving it in the way we gave it and with the significance which we attached to the different groups, he has modified it to suit his present purposes, thereby, in my opinion, almost entirely destroying its value. Perhaps under these circumstances it is as well that he does not state the source whence he obtained it.

The subfamily Chalininæ is described on p. 761 as follows :—" Homorrhaphidæ mit mächtiger Entwicklung des Spongins—Cornacuspongiæ mit einem Skelet, welches aus einem Netz von Hornfasern besteht, in denen Stabnadeln eingelagert sind. Mit unbedeutenden Subdermalräumen, einfachem Canalsystem und ziemlich grossen, kugligen Geisselkammern, welche mit einer kleinen Ausströmungsöffnung versehen sind. Mit nahezu hyaliner Grundsubstanz. Die Skeletfasern sind nicht durch vorstehende Nadeln stachelig. Fleischnadeln, wenn vorhanden, einfach, Toxius, Sigma, Amphitoxius, Spirula, Spirobacter. Keine Anker."

Now perhaps the most important feature of the classification proposed by Mr. Ridley and myself is the erection of the family Homorrhaphidæ to include those *Halichondrina* which

* One of the most important features of our Preliminary Report was the use of the term *Desmacidonidæ* to include all those Halichondrine sponges in which chelæ (anchorates) occur, and our diagnosis runs :—" Family 3. Desmacidonidæ. Skeleton-spicules of various forms. Anchorate flesh-spicules normally present." It is therefore rather surprising to find, on p. 732 of Dr. von Lendenfeld's work, the passage " Anders verhält es sich mit den Ankern. Diese bilden ein verwerthbares Criterium, und ich vereinige deshalb auch alle Cornacuspongiæ mit Ankern in eine Gruppe, Desmacidonidæ," without the slightest reference to the fact that we had already done precisely the same thing.

possess only diactinal megasclera and *no* microsclera; and Dr. von Lendenfeld, as we have seen, himself describes them as being "ohne differente Fleischnadeln." What, then, are his "Toxius, Sigma, Amphitoxius, Spirula, Spirobacter," if not "differente Fleischnadeln"? and how can he possibly include such forms as possess these spicules amongst the Chalininæ?

It has been demonstrated again and again by various authors that the mere possession of a large amount of spongin in the skeleton is not a sufficient guide to the systematic position of a sponge; and to found a group on this character alone is totally out of accord with the present state of our knowledge. Spongin is enormously developed in many of the Desmacidonidæ, and it also occurs abundantly in the Heterorrhaphidæ and Axinellidæ.

Amongst the Heterorrhaphidæ the subfamily Gelliinæ (Ridley and Dendy) is characterized by the presence of diactinal megasclera and microsclera in the form of sigmata or toxa. It contains three genera, *Gellius*, Gray, *Gelliodes*, Ridley, and *Toxochalina*, Ridley. *Gelliodes* differs from *Gellius* solely in the possession of a larger proportion of spongin in the skeleton; and yet Dr. von Lendenfeld removes *Gelliodes* from the Gelliinæ and places it amongst the Chalininæ; and he does the same with *Toxochalina*, which also happens to possess much spongin. If he thinks that the characteristic microsclera (sigmata and toxa) of these two genera are not sufficiently "differente"* to justify their separation from the Chalininæ then the whole family Heterorrhaphidæ must, for him, fall to the ground, for none of the genera therein included, except *Vomerula* and *Hamacantha*, have more "differente" microsclera; but he accepts the family in his classification. It is clear that *Gelliodes* must go where *Gellius* goes, the mere presence of a greater or less amount of spongin cannot in this case be regarded as of more than generic value; but no one would think of calling *Gellius* a Chalinine sponge.

In fact it is obvious that we must depend on spicules rather then on spongin for guides to classification. In putting such forms as *Gelliodes* and *Toxochalina* amongst the Chalininæ Dr. von Lendenfeld does away at once with all distinction between the Homorrhaphidæ and Heterorrhaphidæ; and under such circumstances he has no business to retain these two groups in his system.

* On p. 797, however, the "subgenus" *Toxochalina* is defined thus:—"Phylosiphoninæ mit differenten Fleischnadeln (Toxii)," which scarcely seems in accordance with the previous statement that the Homorrhaphidæ, as a family, are "ohne differente Fleischnadeln" (p. 761).

The close relationship between the Chalininæ and Renierinæ is now fully demonstrated, and if further proof were needed I think I may fairly claim to have given it in my recent papers on the West-Indian Chalininæ * and on *Pachychalina spinosissima* †. Indeed the distinction between the two groups is an arbitrary one and of a quantitative rather than a qualitative character. Hence the two are united together in one family under the name Homorrhaphidæ, and I still think that the family Homorrhaphidæ, as constituted by Mr. Ridley and myself, is a fairly natural one; but it would certainly no longer be so were we to include therein the genera *Gelliodes* and *Toxochalina* ‡.

It would be too long and too difficult a task to offer in this place any detailed criticism of Dr. von Lendenfeld's arrangement of his Chalininæ; but for the information of the reader I will briefly give the classification of the group proposed by him. For diagnoses of the different subdivisions the reader is referred to the original memoir.

Subfamilia CHALININÆ.

1. Tribus CHALININÆ RETICULATÆ.

I. Gruppe CACOCHALININÆ.

1. Genus *Cacochalina*, O. Schmidt, 1870.
2. „ *Chalinopora*, n. g.
3. „ *Cladochalina*, O. Schmidt, 1870, emend.
4. „ *Chalinella*, n. g.

II. Gruppe PACHYCHALININÆ.

5. Genus *Chalinissa*, n. g.
6. „ *Pachychalina*, O. Schmidt, 1868, emend.
7. „ *Ceraochalina*, n. g.
8. „ *Chalinopsis*, O. Schmidt, 1870.

III. Gruppe PLACOCHALININÆ.

9. Genus *Antherochalina*, n. g.
10. „ *Euplacella*, n. g.
11. „ *Placochalina*, n. g.
12. „ *Platychalina*, Ehlers, 1870.

IV. Gruppe GELLIODINÆ.

13. Genus *Gelliodes*, Ridley, 1884.
14. „ *Spirophora*, n. g.

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* Abstracted in Proc. Zool. Soc. 1887, p. 503.

† *Loc. cit.* p. 524.

‡ I take these as examples. Dr. von Lendenfeld also includes other genera, such as *Spirophora*, n. g. (= *Trachycladus*, Carter), which, in my opinion, have no business in the group.

V. Gruppe Siphoninæ.

15. Genus *Sclerochalina*, O. Schmidt, 1868.
16. „ *Phylosiphonia*, n. g.
    1. Subgenus *Toxochalina*.
    2. „ *Anatoxius*.
17. „ *Siphonochalina*, O. Schmidt, 1868, emend.
18. „ *Dasychalina* *, Ridley and Dendy, 1886.
19. „ *Siphonella*, n. g.

VI. Gruppe Euchalininæ.

20. Genus *Dactylochalina*, Lendenfeld, 1885.
21. „ *Euchalinopsis*, n. g.
22. „ *Euchalina*, n. g.
23. „ *Chalinodendron*, n. g.

VII. Gruppe Arenochalininæ.

24. Genus *Arenochalina*, n. g.

VIII. Gruppe Chalinorhaphinæ.

25. Genus *Chalinorhaphis*, n. g.

2. Tribus Chalininæ dendroidæ.

IX. Gruppe Hoplochalininæ.

26. Genus *Hoplochalina*, n. g.

Such, then, is Dr. von Lendenfeld's arrangement of the group; I leave it to speak for itself, and will proceed at once to discuss the nomenclature adopted by him for the genera and species.

III. *The Nomenclature of Genera and Species.*

On this subject a great deal might be said; but I will endeavour to make my remarks as short as possible.

That Dr. von Lendenfeld holds very peculiar views on the subject of zoological nomenclature will be evident from what follows.

Firstly with regard to his new genera, I would venture to point out that the very remarkable genus *Spirophora* appears to be thoroughly identical with Mr. Carter's *Trachycladus*, of which the type species (possibly identical with one of those described by Dr. von Lendenfeld) was fully described so far

* Dr. v. Lendenfeld remarks, "Diese Gattung soll eingezogen werden, wie Mr. Dendy mittheilt." This is quite true; but he does not say what is to become of the three species included in it, viz. *D. fibrosa*, *D. fragilis*, and *D. melior*. In our 'Challenger' Report we have included these three species in the genus *Pachychalina*.

back as 1879 *. I have examined Dr. von Lendenfeld's specimens of "*Spirophora*," and cannot conceive what possible claims they have to be included amongst the Chalininæ. The genus *Trachycladus*, as it must of course be called, is certainly a difficult one to locate; but it seems to me that it would be difficult to place it in a much less appropriate position.

The creation of the new genus *Phylosiphonia* would seem to be equally unfortunate. It is a comprehensive genus, and includes species both with and without microsclera. Accordingly it is divided into two subgenera :—(1) *Toxochalina* †, with microsclera, and (2) *Anatoxius*, without microsclera. The author seems a little doubtful as to the generic nomenclature of the species described by him under the subgenus *Toxochalina*, so that we have the following curious result :—

" 1. *Toxochalina foliodes* Lendenfeld.

" *Toxochalina foliodes* Ridley.

" 2. *Phylosiphonia robusta* Lendenfeld.

" *Toxochalina robusta* Ridley."

All the remaining species, both of *Toxochalina* and *Anatoxius*, are described under the generic name *Phylosiphonia*.

But it is very difficult to understand why the new genus *Phylosiphonia* should have been introduced at all. The type species of Schmidt's genus *Siphonochalina* (*S. coriacea*) is actually included in the list of species of *Phylosiphonia*, where it figures under the name "*Phylosiphonia coriacea* Lendenfeld." Obviously then *Siphonochalina* is the correct generic name for all those species of "*Phylosiphonia*" which have no microsclera (subgenus *Anatoxius*, Lendenfeld), while the correct generic name for those with microsclera (toxa) is *Toxochalina*, Ridley. To make *Toxochalina*, Ridley, generically identical with *Siphonochalina*, Schmidt, appears to be an altogether unwarrantable proceeding.

If possible the confusion here introduced is still worse confounded by the fact that Dr. von Lendenfeld actually uses Schmidt's name *Siphonochalina* for some of those species of tubular Chalininæ " mit conulöser Oberfläche," and calls the genus "*Siphonochalina* O. Schmidt 1868 emend.," quite regardless of the fact that Vosmaer‡ had already created a genus, *Spinosella*, which includes the conulose or spinose

* Ann. & Mag. Nat. Hist. May 1879, p. 343.
† Ridley's genus.
‡ Bronn's Klass. u. Ordnung. des Thierreichs, Porifera, p. 342.

species, as opposed to the genus *Siphonochalina*, Schmidt, which includes the smooth species, the type species of *Siphonochalina*, *S. coriacea*, being perfectly smooth, as shown by Schmidt's illustration thereof *.

In short, the tubular Chalininæ (excluding those forms with microsclera, which I cannot regard as Chalininæ at all) may be very simply dealt with by dividing them between the two genera *Siphonochalina*, Schmidt, and *Spinosella*, Vosmaer. The new genus *Phylosiphonia* is then quite superfluous; and the same remark also applies to Dr. von Lendenfeld's new genus *Siphonella*, whose species come under *Spinosella*, Vosmaer.

The peculiarities in nomenclature, however, show themselves most strikingly in the case of the specific names. In the first place Dr. von Lendenfeld attaches his own name to every species which he places in a genus different from that to which its real author had assigned it, thus, as it were, capturing all stray species and taking forcible possession of them. This fact gives us some insight into his method of working, but it does not explain by any means all the noticeable peculiarities.

Probably the printers have had some hand in the remarkable transformation of "*Pachychalina lobata* Ridley," into "*Chalinissa oblata* Lendenfeld," as in the case of several other minor errors which need not be enumerated. We cannot, however, thus explain the nomenclature of the author's "*Ceraochalina papillata* n. sp." This new species includes the following, as given by its founder:—

Ceraochalina papillata n. sp.

I. *Varietas pergamentacea.*

Cladochalina armigera var. *pergamentacea* Ridley.
Cladochalina pergamentacea Ridley.

II. *Varietas armigera.*

Cladochalina armigera O. Schmidt.
Cladochalina armigera Ridley.

III. *Varietas macropora.*

IV. *Varietas intermedia.*

V. *Varietas micropora.*

* Spong. d. Küste v. Algier, Taf. ii. fig. 4.

Whatever may be the real name of this comprehensive species, it certainly cannot be "*Ceraochalina papillata* n. sp."!

Again, let us take the following :—

Ceraochalina nuda Lendenfeld.

I. *Varietas oxyus.*

Cladochalina nuda Ridley.

II. *Varietas oxystrongylus.*

Cladochalina nuda, var. *abruptispicula* Ridley.

This is beyond comment.

On p. 813 "*Chalina monilata* Ridley" is avowedly described under the name "*Dactylochalina australis* Lendenfeld," and on p. 815 we are informed that "*Chalina oculata* Bowerbank" is "Unten als *Euchalinopsis oculata var. elegans* Lendenfeld, beschrieben"; var. *elegans*, however, does not again make its appearance, but under "*Euchalinopsis oculata* Lendenfeld," we find *Chalina oculata*, Bowerbank, given as a synonym.

This free-and-easy system of nomenclature is doubtless very convenient for one engaged in the description of genera and species, and saves a good deal of time and trouble; but it can scarcely be recommended as being well adapted to promote our zoolcgical knowledge.

The nomenclature of sponges is already in a state of dire enough confusion and does not require to be made any more involved. It is very tempting to overthrow the work of previous authors and make a fresh start on one's own account; but it can scarcely be expected that such a method will obtain the approval of other workers. I do not wish to enter into any zoological polemics, but as a zoologist, and more especially as a spongologist, I feel bound to enter a protest against such a mode of procedure.

At the same time I do not wish in the slightest degree to underestimate the value of Dr. von Lendenfeld's important contribution to our knowledge of the Chalininæ. He undertook and has completed a most difficult and laborious task; and I would especially call attention to the nine beautiful photographic plates of external form which accompany his memoir, the value of which for the identification of species can scarcely be overestimated.

XLIV.—*A List of the Japanese* Silphidæ.

By George Lewis, F.L.S.

The following is a list of the Japanese Silphidæ, consisting of twenty-three species, of which three are treated of as new.

Necrophorus concolor, *Kraatz.*
—— japonicus, *Harold.*
—— maculifrons, *Kraatz.*
—— montivagus.
—— 4-punctatus, *Kraatz.*
—— latifasciatus.
—— mortuorum, *Fabr.*
—— tenuipes.
Ptomascopus morio, *Kraatz.*
—— plagiatus, *Ménétr.*, *Motsch.*
4-*maculatus*, Kraatz.
Davidis, Fairm.
plagiatipennis, Lewis.
Necrodes littoralis, *Linn.*
—— nigricornis, *Harold.*
Silpha japonica, *Motsch.*
—— brunnicollis, *Kraatz.*
—— venatoria, *Harold.*
—— perforata, *Gebler.*
—— sylvatica, *Lewis.*
—— sinuata, *Fabr.*
—— rugosa, *Linn.*
—— thoracica, *Linn.*
—— subrufa, *Lewis.*
—— nigropunctata, *Lewis.*
—— atratus, *Linn.*

The Silphidæ have a curious habit, common enough also with other insects, and well known to every one who studies them, of remaining stationary when alarmed, with outstretched legs and with the head and thorax bent towards the abdomen. The attitude is often expressed as "the feigning of death;" but what the beetles really do in assuming this posture is to bring the edges of the hard chitinous epidermis together, and this is the only position in which the edges can meet. When the insects are active and the head on a plane with the thorax the soft membranous parts between the hard segments are exposed, and it is presumable that a wound or injury to these frail structures would be very harmful, if not mortal. We sometimes find a beetle with part of its chitinous covering broken or bruised; but it is probable that unless the membranous part beneath (for it extends under it) is injured, the damage done to the insect is not by any means immediately fatal. If, as suggested, the piercing or lacerating of the membranous film is mortal, there is a manifest object in the animal covering it when disturbed. Dr. Sharp, in an interesting paper on *Hypocephalus armatus*, Desmarest (C. R. ent. Belg. xxviii.), has already written on this subject.

The stationary posture of the imago is similar to the recumbent attitude of the insect when it is a pupa, except that the legs are free. When the beetles "feign death" their legs are thrust out away from the body, and this action closes the

coxal cavities; but to us it gives an appearance of great helplessness, as the insect lies on its back or side.

What the special enemies of *Necrophorus* are, or what the conditions of its life most disadvantageous to it may be, I cannot say. *Acari* often swarm on their bodies, but they do not apparently hurt the imagos, although we may well conceive that they are a source of intense discomfort to them. Hasty flight is apparently of less importance than the covering-up of the membranous surface; yet after a minute or so the beetles run away fast enough. *Creophilus maxillosus*, Linn., is a common English species which "feigns death" before running, and the large larvæ of Sphingidæ, with retractile heads, will remain stiff on their food-plants, although they will jerk and sway their heads to and fro on the arrival of an ichneumon. They will not crawl when first alarmed.

Another benefit accruing from the closing of the harder plates over the thin membranous parts is that when the insects are hybernating or in repose desiccation is less, and the vital capital of the beetle is longer retained. It would thus get less hungry. It seems also that the chitinous part of the epidermis is the only portion of it which is exposed to the chemical action of the air &c. while the imago is yet soft after transformation; and this doubtless has always been an important incident in the economic history of a species.

1. *Necrophorus concolor*, Kraatz.

Necrophorus concolor, Kraatz, Deutsche ent. Zeitschr. 1877, p. 100.

This species is abundant in South Japan and has been taken in Sado. It measures 30–36 millim., and is black, with a yellow club to the antenna.

2. *Necrophorus japonicus*, Harold.

Necrophorus japonicus, Harold, Deutsche ent. Zeitschr. 1877, p. 345.

The hind tibiæ of this insect are incurved in the male and the internal spine on the trochanter is long and conspicuous. The largest example in a series of fourteen specimens measures 27 millim.

Found at Nagasaki, Hiogo, and Yokohama.

3. *Necrophorus maculifrons*, Kraatz.

Necrophorus maculifrons, Kraatz, Deutsche ent. Zeitschr. 1877, p. 101.

Harold (*l. c.* p. 346) considered this species to be the same as *N. nepalensis*, Hope (Zool. Misc. 1831, p. 21); but this

determination is not correct. The type of *nepalensis* is in the British Museum, and has been carefully examined and compared by Mr. C. O. Waterhouse and myself with Japanese specimens which are undoubtedly Kraatz's *N. maculifrons*, and it is certain that the species are distinct.

I have taken it at Nikko, Hiogo, and Yokohama.

4. *Necrophorus montivagus*, n. sp.

Præcedenti similis, sed multo minor; antennarum clava partim nigra; elytris fasciis duabus rufis. L. 11–14 mill.

This species differs from *N. maculifrons*, Kraatz, in being much smaller; the antennæ, especially the basal joint, stouter, with the apical joint alone red. It has also no frontal red spot, and the red fasciæ of the elytra in most specimens are less encroached upon by the black denticulation of the other part. The thorax is rounder and anteriorly less widened. The trochanters, like those of *N. maculifrons*, are simply bifid.

I obtained this insect first at Chiuzenji in June 1880, and on August 22, 1881, I took a series of twenty near the waterfall there, in bottles set with meat.

5. *Necrophorus* 4-*punctatus*, Kraatz.

Necrophorus 4-*punctatus*, Kraatz, Deutsche ent. Zeitschr. 1877, p. 100.

Kraatz considered this a variety of *N. maculifrons*; but beyond the colour there are other characters by which to separate it. The hind tibiæ in the male are swollen on the external surface, and the thorax is more rotundate. In the female the hind tibiæ are like those of the male of *N. maculifrons*.

I have one specimen in which the elytra are wholly black, and twelve others with the red bands as described by Kraatz, each having two isolated black spots.

It occurs in Central and South Japan, and is not uncommon.

6. *Necrophorus latifasciatus*, sp. n.

Niger, vix nitidus; elytris transversim late fasciatis, fasciis duabus rufis. L. 14–16 mill.

This species is similar in outline to *N.* 4-*punctatus*, Kraatz, but differs in the following essential details:—The head is much more enlarged behind the eyes, the thorax is dilated in front (as in *N. japonicus*, Harold), the elytra are more densely punctured, with interstices somewhat coriaceous, the red bands are broad and only touch the base of the elytron under the

humeral angle, and the bands are not interrupted at the suture, the elytral striæ are less distinct, and the hind tibiæ of the male are straight and not swollen externally. In *N. 4-punctatus* the trochanter is simply bifid, but in *N. latifasciatus* the internal spine is obtuse and hamate. I have four examples of this species, and in all the mesosternum is thickly clothed with a golden pubescence. Three of them are males, and one, which I think is of the other sex, has the trochanter simply bifid; but I am not sure about this, as the head is not enlarged behind the eyes and the clypeus has a small triangular red membranous space, which may be a character of an undeveloped male.

Found at Sapporo and on Mount Niohozan.

7. *Necrophorus mortuorum*, Fabr.

Necrophorus mortuorum, Fabr. Ent. Syst. i. p. 248.

Three examples were taken at Nikko and two at Sapporo. It occurs also in Europe, Asia, and North America.

8. *Necrophorus tenuipes*, sp. n.

N. humatori similis, at paulo minor; pedibus gracilibus; antennarum clava nigra. L. 15–19 mill.

The sculpture of this species is very similar to that of *N. humator*, Fabr.; but the club of the antennæ is black and more lax, and the frontal sulci are more arched at the sides and much less widened out before the neck. The legs and antennæ are more slender, but I see no other differences.

I saw it in plenty on Nantaizan, August 20th, 1881, but most of the specimens were drowned in a tub containing rotten fish left by pilgrims, and only three good ones were secured.

9. *Ptomascopus morio*, Kraatz.

Ptomascopus morio, Kraatz, Deutsche ent. Zeitschr. 1877, p. 104.

Found in all the islands.

10. *Ptomascopus plagiatus*, Ménétr.

Ptomascopus plagiatus, Ménétr., Motsch., Etud. Ent. 1854, p. 27.

The synonymy of this species is first given in the 'Entomologist,' Oct. 1887. It is not unfrequent near Pekin, and I have taken it at Kiu Kiang, on the Yangtsze Kiang. I have only one Japanese specimen.

11. *Necrodes littoralis*, Linn.

Necrodes littoralis, Linn. Fn. Suec. p. 450.

Is not common in Japan.

12. *Necrodes nigricornis*, Harold.

Necrodes nigricornis, Harold, Deutsche Abhandl. nat. Ver. Bremen, 1875, p. 286.

This is one of the commonest of the Japanese Coleoptera, and occurs both inland and on the coast.

The descriptions of *Silpha sylvatica*, *subrufa*, and *nigropunctata* are given in the 'Entomologist,' Oct. 1887.

[*Note.—Eudœmonius*, suprà p. 72, must be changed to *Eutriplax*, as the first name has been used in Lepidoptera.]

XLV.—*On the so-called* Microdon nuchalis, *Dixon, from the Chalk of Sussex, a new Species of* Platax. By A. Smith Woodward, F.G.S., F.Z.S., of the British Museum (Natural History).

In his well-known work on 'The Geology and Fossils of Sussex' (p. 369, pl. xxxii. fig. 7) Mr. Frederic Dixon figured and briefly noticed a small deep-bodied fish from the Chalk of Washington, Sussex, which he referred to the Pycnodont *Microdon*, and considered to represent a new species of that genus, named *M. nuchalis*. The paragraph and figure were reprinted, without comment, in the revised edition of the work in 1878, and, so far as I am aware, the determination has hitherto been accepted as correct.

The original specimen, however, is now preserved, with Mr. Dixon's other fossils, in the British Museum, and a recent study of its characters has shown that it is in no respects allied to the Pycnodontidæ, but rather belongs to a truly Teleostean genus. The fossil is too fragmentary to allow of any very precise determination, but sufficient is preserved to indicate approximately its affinities; and as it evidently represents a family hitherto undetected in the English Chalk, I propose briefly to enumerate the most important of its structural features.

The specimen is shown of the natural size in Mr. Dixon's figure already quoted, though the details unfortunately are but slightly marked. It comprises a large portion of the crushed head, the pectoral and pelvic arches, the abdominal portion of the vertebral column, with some remains of dorsal interspinous bones, and a fragment of the caudal region. None of the sutures between the bones of the head can be distinguished, but part of the supraoccipital is conspicuous, from its being extended upwards in the form of a strong, laterally compressed, triangular crest. The facial profile is very steep and the orbit is relatively large. The remains of two or three branchiostegal rays are recognizable, and possibly also the bases of some minute hollow teeth in the jaws. The vertebræ, with their arches, are well ossified, and there are apparently ten in the abdominal region, while all but six of the caudal have been destroyed. The centra are much broken, so that it seems impossible to determine their exact form and characters. As in the skull, the elements of the pectoral arch are undistinguishable, and these are somewhat displaced backwards, both the so-called "pelvic" bones and the first interhæmal of the anal fin being crushed together with them. Of the pectoral fins no fragments remain; but each of the pelvic fins is represented by a single robust spine, all the soft rays, if ever present, having disappeared. The three small spines in advance of the anal fin are also preserved; and above the vertebral column, behind the supraoccipital crest, are a number of large, broad, interspinous bones, evidently testifying to the original presence of a very high dorsal fin. There are no traces of scales, which must thus have been either very delicate or absent.

Such being the only characters shown by the fossil, it is obviously impossible to determine its exact position in the Teleostean series by a reference to ordinary systematic diagnoses. A careful comparison, however, with known types can leave no doubt that the Chalk species is an ally of the existing Carangidæ, and must thus be placed in this family or among the less differentiated forms, ancestral to the Carangidæ, which flourished in the later Mesozoic seas. So far as preserved, indeed, the fossil is almost identical with certain more perfect specimens from the Upper Chalk of Mount Lebanon, which have been referred, with much probability of correctness, to the still-surviving genus *Platax* *. The only

* F. J. Pictet, 'Poissons Fossiles du Mont Liban,' 1850, p. 19, pl. ii. fig. 1; F. J. Pictet and A. Humbert, 'Nouv. Rech. Poiss. Foss. M. Liban,' 1866, p. 48, pl. iv. figs. 1–3; J. W. Davis, "On the Fossil Fishes of the Chalk of Mount Lebanon," Trans. Roy. Dublin Soc. [2] vol. iii. (1887), p. 524, pl. xxv. fig. 4.

essential differences appear to be due to imperfections in preservation; the facial profile at first sight seems sharply bent opposite the orbit, but this appearance is really due to a detached bone-fragment; the difference in the lower jaw is similarly owing to breakage, and so likewise is the deceptive appearance of elongation in the vertebral centra. The fish must thus be known by the provisional name of *Platax nuchalis*, until the discovery of more satisfactory specimens renders it possible to clearly define the species.

It may also be interesting to point out, in connexion with this subject, that another Cretaceous fish, truly Teleostean so far as can be judged from the figure and description, has been doubtfully referred to the Pycnodont *Microdon*. This is a small fossil from Mount Lebanon, made known by Mr. James W. Davis under the name of *Microdon? pulchellus* *.

XLVI.—*List of Reptiles and Batrachians from Cyprus.*

By G. A. Boulenger.

At the request of Dr. Günther I herewith give a list of the Reptiles collected by Dr. Guillemard in Cyprus for Lord Lilford, and presented by the latter to the British Museum.

All the species enumerated were previously known to occur in Cyprus †. Fortunately there is one specimen of the rare *Acanthodactylus Schreiberi* in the collection. The species peculiar to the island are marked with an asterisk.

Lizards.

1. *Agama stellio*, L.

*2. *Acanthodactylus Schreiberi*, Blgr. (*A. Boskianus*, Gthr., *A. Savignyi*, Bttg.)

*3. *Ophiops Schlueteri*, Bttg. (*O. elegans*, Gthr.).

Two female specimens, both with 42 scales round the body. Femoral pores 13–14 and 14–14.

* J. W. Davis, *loc. cit.* p. 501, pl. xxiv. fig. 3.

† *Cf.* Günther, P. Z. S. 1879, p. 741, and Böttger, Ber. Senck. Ges. 1879–80, p. 132.

4. *Eumeces Schneideri*, Daud.

Five specimens, three with 26, two with 24 scales round the middle of the body.

5. *Chalcides ocellatus*, Forsk.

A single specimen, belonging to the var. *A* (B.M. Cat. Liz. iii. p. 401).

6. *Chamæleon vulgaris*, Daud.

Snakes.

7. *Typhlops vermicularis*, Merr.

8. *Tropidonotus natrix*, L.

9. *Zamenis atrovirens*, Shaw.

10. *Zamenis Ravergieri*, Mén.

11. *Cœlopeltis lacertina*, Wagl.

12. *Vipera euphratica*, Mart.

Frogs.

13. *Rana esculenta*, var. *ridibunda*, Pall.

14. *Hyla arborea*, var. *Savignyi*, Aud.

XLVII.—*On the Affinity of the North-American Lizard-Fauna.* By G. A. Boulenger.

A recent work on the geographical distribution of animals, by Prof. Angelo Heilprin (Intern. Scientific Series, vol. lviii. 1887), contains the following remark (p. 317):—

"M. Boulenger has recently attempted to show (Ann. & Mag. Nat. Hist. August 1885) that the North- and South-American Lacertilian faunas are, strictly speaking, one, the Neogean, a conclusion which is not borne out by the facts of distribution. The misconception arises from the incorporation of the tract lying south of the line indicated above [a line drawn from San Francisco to Galveston, in Texas] with the North-American faunal region proper, while in reality it is a transition-tract more nearly Neotropical in character than Nearctic."

What the facts are that do not bear out my conclusion the author omits to state, unless they be the presence of the "Old-World genus of skinks, *Eumeces*" (p. 316) and of the glass snake (*Ophisaurus*). With the latter I have dealt in the essay referred to, and shown that the Anguidæ, of which family *Ophisaurus* is a member, are essentially American, reaching their fullest development in Central America; that they are well represented in North and South America, and occur in two genera and three species in the Palæarctic region; and that if the affinity between *Ophisaurus* and *Pseudopus* is great, that between *Anguis* and the South-American *Ophiodes* is scarcely less. The idea that *Eumeces* is an Old-World genus is erroneous. As now characterized it embraces thirty-one species, of which twenty-one are American (only half that number extending north of Mr. Heilprin's line), nine Old-World, and one of unknown habitat. But, far better than any discussion, the following list of the few Lacertilia of British Columbia (a district well beyond the debatable area and also the northernmost point reached by lizards in North America) will answer Mr. Heilprin's criticism, in showing that even so far north that part of the fauna is purely Neogean.

Lacertilia of British Columbia *.

Iguanidæ ..	1. *Sceloporus gratiosus.* 2. —— *undulatus.* 3. *Phrynosoma Douglassii.* 4. —— *cornutum.*
Anguidæ ..	5. *Gerrhonotus cæruleus.*
Scincidæ ..	6. *Eumeces Skiltonianus.*

All four genera attain their greatest development south of Mr. Heilprin's line.

A list of the lizards of any northern district of the United States would equally well support my view. Indeed I can only repeat my statement (*l. c.* p. 80), that the North-American lizards constitute no essentially distinct fauna, but are merely an offshoot of that of Central America.

* *Cf.* J. K. Lord, Brit. Columb. ii. pp. 302, 307, and 308.

XLVIII.—*Notes on* Volutharpa Perryi.

By Edgar A. Smith.

The British Museum has recently obtained two specimens of *Volutharpa Perryi*, collected by Mr. H. Pryer at the Loo-Choo Islands. Only two brief notices of the animal of this species have been published, by Troschel* and Dunker†. The latter's account reads almost like a latin translation of the description of *V. ampullacea* given by A. Adams ‡. Troschel more particularly describes the odontophore and notes (erroneously?) the absence of an operculum. From an examination of the two specimens at hand I have drawn up the following description.

The animal (in spirit) is of a pale orange colour, copiously mottled with black on the head, tentacles, siphon, and upper part of the body. The creeping-disk is similarly coloured, but the lateral edges are unspotted. The body is rather large, narrowed posteriorly, and somewhat squarish in front, where there is a free edge, distinct from the foot-margin, as in *Buccinum*. The head, tentacles, and the position of the eyes are about the same as in *B. undatum*. The odontophore, which I have examined, does not quite correspond with the figure given by Troschel. The central teeth have six similar dentations, but the lateral plates are more regular than those depicted in his work; those on one side constantly have five dentations, those on the other six. The outside tooth is the largest, the innermost the next in size, the rest gradually diminishing, so that the fourth on the one plate and the fifth on the other, or, in other words, those next to the large outer teeth, are the smallest.

The most remarkable point in connexion with this species is the minuteness of the operculum, which has only a diameter of $1\frac{3}{4}$ millim. It is oval, very thick for its size, and externally appears to consist of four or five concentric layers. The under surface is excavated and irregular, but exhibits to some extent a concentric character of growth.

Troschel states that his specimen was without an operculum; but it seems to me quite possible that he may either have overlooked it on account of its minuteness, or it may have been knocked off, as is the case in one of the two specimens under examination. Its former presence, however, is

* 'Das Gebiss der Schnecken,' vol. ii. p. 72, pl. vi. fig. 14.
† Index Mollusc. Japon. p. 33.
‡ Ann. & Mag. Nat. Hist. 1860, vol. vi. p. 109.

indicated by the very small operculigerous disk on the upper surface of the hind part of the foot.

Dall * has shown that with regard to *V. ampullacea*, an allied form from the Ochotsk Sea, &c., the operculum is indifferently present or wanting. It may therefore be the same with the present form.

The shell of this species differs from that of *V. ampullacea* in several points. It is usually thinner, has a deeper siphonal notch, a more acuminate spire, a non-canaliculate suture, and a more velvety epidermis; and adult specimens are usually larger than any examples of *V. ampullacea* that I have ever seen. The largest specimen in the Museum is 53 millim. long, whilst the finest example of the Ochotsk species has only a length of 46. The record of this species at Loo-Choo is interesting, as showing how far south species essentially of boreal type may be expected to extend.

XLIX.—*Descriptions of some new Genera and Species of Curculionidæ, mostly Asiatic.*—Part IV. By Francis P. Pascoe, F.L.S. &c.

Brachyderinæ.

Dermatodes mirandus.

Otiorhynchinæ.

Episomus gemmeus.
—— uniformis.
—— laticollis.

Hylobiinæ.

Hylobius arrogans.
—— desuetus.
—— pumilus.
—— clathratus.
Dirodes, n. g.
—— russatus.

Molytinæ.

Euthycus incisus.

Tanyrhynchinæ.

Exætoderes, n. g.
—— scabripennis.

Alcidinæ.

Alcides gallus.
—— tetanicus.
—— censorius.
—— vestitus.
—— nitidus.
—— geminatus.
—— Oberthürii.
—— collaris.

Baridinæ.

Baris cælestis.
—— eburifera.
Acythopeus genuinus.
—— funereus.
Lystrus longimanus.

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* American Journ. Conch. vol. vii. p. 105.

Dermatodes mirandus.

D. ovatus, squamis læte viridibus, aliis maculatim aureo-nitidis, tectus; rostro capite continuato; antennis funiculo clavaque nigris. Long. $5\frac{1}{2}$ lin. (rostr. incl.).

Hab. Zanzibar.

Ovate, densely covered with rich glossy green scales, with golden scales interspersed; head not broader than the rostrum and without the groove separating them; antennæ with the scape passing behind the eye, the funicle filiform, black, the club also black, but covered with a whitish pubescence; prothorax moderately transverse, broad at the base, the sides slightly rounded; scutellum small, distinct; elytra convex, gradually narrowing towards the apex, striate-punctate, striæ very shallow; corbels of the posterior tibiæ densely covered with whitish hairs; claw-joint elongate.

A richly coloured species, with an exceptionally long scape; the length, however, varies according to the species; in some it does not or scarcely attains the eye, *D. cæsicollis* for example; in others it impinges more or less on it.

Episomus gemmeus.

E. oblongo-ovatus, niger, squamis viridi-aureis vestitus; antennis funiculo tenuato, clava pyriforme sed apice acuta; capite rostroque linea angusta longitudinaliter impresso. Long. $6\frac{1}{2}$ lin. (rostr. incl.).

Hab. Sumatra.

Oblong, ovate, black, clothed above, but not closely, with golden-green scales, beneath, and especially the femora, with close-set, mostly paler scales; antennæ with a comparatively slender funicle, its second joint elongate, the club pyriform, with the apex somewhat produced and pointed; prothorax with slightly impressed transverse grooves at the sides, and with two black stripes on the disk; elytra punctured, the scales confined to the punctures.

The species of *Episomus* are so variable in coloration that very little reliance can be placed on it to differentiate them; the sculpture also is not very definite. The specimen here described has unusually lustrous scales, a comparatively slender funicle, a club tapering at the base, with a somewhat produced and pointed apex, &c. It may possibly be *E. gracilicornis*, very shortly described by Ritsema, but which is said by Chevrolat not to be a true *Episomus*.

Episomus uniformis.

E. ovatus, omnino griseo-squamosus; antennis funiculo crasso,

articulis 3°–6ᵐ brevissimis, septimo elongato, cylindrico, nigro; rostro quam caput ad apicem latiore; prothorace flexuoso-sulcato. Long. $5\frac{1}{2}$–7 lin.

Hab. Andaman.

Ovate, entirely covered with brownish-grey scales; antennæ rather slender, black, the third to the sixth joint very short, the seventh elongate, cylindrical, and closely united to the short club; rostrum somewhat broader at the apex than the head; prothorax with irregular, flexuous, transverse grooves; elytra striate-punctate, interstices narrow, slightly raised, each elytron with a black spot posteriorly; body beneath and legs closely covered with small pale grey scales and a few markedly larger ones intermixed on the former, the legs with a few scattered setæ.

A uniformly grey or brownish-grey species, with the third to the sixth joint of the funicle markedly short, the seventh elongate, &c.

Episomus laticollis.

E. ovatus, obscure griseo-squamosus; prothorace valde transverso, utrinque rotundato, sulcis tribus impresso; elytris striato-punctatis, interstitiis setigeris. Long. 4 lin.

Hab. Pachebon.

Ovate, covered with dull greyish scales; antennæ with a short, nearly straight scape; funicle moderately long, the seventh joint closely united to the short ovate club; head and rostrum broad, with a continuous median groove and a shallower one on each side; prothorax very transverse, rounded at the sides, slightly pitted, and with three shallow grooves towards the base; elytra striate-punctate, the interstices slightly raised, each with a row of pale setæ; body beneath and legs with greyish scales and setæ.

Allied to *E. iconicus*, in which, as in the above, the scutellum is apparently absent; it has, however, *inter alia*, a shorter and much broader prothorax; the upper edge of the scape is nearly straight.

Hylobius arrogans.

H. robustus, fuscus, opacus, squamulis setulisque adspersus; rostro incrassato, grosse punctato; prothorace rugoso-granulato, basi latiore; elytris prothorace multo latioribus, seriatim punctatis, punctis mediocribus, quadratis; apice conjunctim rotundato. Long. 8 lin.

Hab. Sumatra.

Robust, dull brown, with a scattered scaly indumentum

mixed with small setæ; rostrum stout, with four raised line , the outer flexuous, the front coarsely punctured; antennæ with the first joint of the funicle twice as long as the second; prothorax not longer than broad, rounded at the sides, but expanding at the base, the disk roughly granulate; scutellum cordiform; elytra very broad at the base, gradually narrower to the broadly rounded apex, seriate-punctate, punctures middle-sized, quadrate; body beneath with scattered punctures, each bearing a brownish-yellow seta, and more numerous at the sides of the abdominal segments; legs sparsely setulose; femora strongly toothed; fore tibiæ slightly curved.

The groove in front of the eye—one of the characters of *Hylobius* according to Lacordaire—is short and not well limited, and the posterior callus on each elytron is nearly obsolete. This species may be placed after *H. crassirostris*.

Hylobius desuetus.

H. robustus, fuscus, subnitidus, setulis fulvidis adspersus; rostro tenuato; prothorace granulis conjunctis setigeris munito; elytris striato-punctatis, interstitiis parte basali granulatis. Long. 6–7 lin.

Hab. Siam, Sarawak.

Robust, rather glossy brown, with numerous small fulvous setæ; rostrum comparatively slender, with three principal grooves marked with coarse oblong punctures; antennæ pitchy; prothorax with the sides nearly parallel posteriorly, the disk with connected granules in oblique lines, each tipped with a curved seta; scutellum triangular; elytra considerably broader at the base than the prothorax, striate-punctate, the punctures oblong, large, approximate, interstices not well marked, those on the basal half dotted with small glossy granules, each tipped with a procumbent seta; femora obtusely toothed.

The more slender rostrum and the less convex elytra, with their interstices granulate, are the leading differential characters of this species. In this and the preceding species there is a tendency of the setulæ to a closer approximation on the elytra behind the middle, forming a somewhat indistinct band.

Hylobius pumilus.

H. oblongus, fusco-ferrugineus, nitidus; antennis, femoribus basi, tibiis dimidio apicali tarsisque rufulis; rostro incrassato, grosse punctato; femoribus dente acuto armatis. Long. 3 lin.

Hab. Sarawak.

Oblong, dark ferruginous, glossy, antennæ, femora at the base, apical half of the tibiæ and tarsi reddish; rostrum stout, strongly marked throughout with oblong punctures; antennæ slender; prothorax without ocular lobes, slightly rounded at the sides, the disk with large, irregular, confluent granules; scutellum triangular; elytra somewhat broader posteriorly, flattish above, striate-punctate, punctures large, approximate, the interstices flat; second abdominal segment as long as the two next together; femora with an acute tooth.

A small flattish species, differing from the genuine *Hylobii* in having no ocular lobes; but they are very slight in *H. papulosus*, after which it may be placed.

Hylobius clathratus.

H. oblongus, niger, parum nitidus, sparse setulosus; rostro subtenuato, sex-sulcato, sulcis intermediis basi approximatis; prothorace oblongo, grosse granulato; elytris punctis quadratis magnis instructis, apicibus paulo divaricatis. Long. 6 lin.

Hab. India.

Oblong, black, slightly glossy, with small pale scattered setæ, more condensed posteriorly; rostrum rather slender, coarsely punctured, with six irregular grooves in front, the two intermediate approximate at the base; antennæ with the two basal joints of the funicle equal; prothorax oblong, a little contracted at the base, coarsely granulate; elytra subcylindrical, the apices slightly divaricate, seriate-punctate, the punctures large, quadrate, the alternate interstices prominent, the intermediate interstices represented here and there by finely raised lines; body beneath sparsely punctured; femora toothed; tibiæ nearly entire.

A very coarsely sculptured species allied to *H. rusticus*, but, *inter alia*, with the posterior callus on each elytron strongly produced; the punctuation of the elytra is also different.

DIRODES.

Hylobio affinis. *Scrobes* valde obliquæ, infra rostrum conniventes. *Oculi* laterales, transversi, fortiter granulati. *Abdomen* sutura prima obsoleta. *Unguiculi* connati.

The claws being united at the base separates Lacordaire's "Pacholenides" (a group of his "tribu Hylobiides") from his group of true "Hylobiides;" but the shorter metasternum and the facies seem to me to indicate that the affinities of this genus are nevertheless with *Hylobius* rather than with either

of the two genera of "Pacholenides" enumerated by Lacordaire.

Dirodes russatus.

D. subcylindricus, rufo-brunneus, sparse setosulus; antennis brevibus; femora dentata; tibiæ anticæ curvatæ. Long. $4\frac{1}{2}$ lin.

Hab. Sumatra.

Subcylindrical, reddish brown, sparingly setulose; head convex in front; rostrum stout, curved, as long as the prothorax, thinly punctured; scrobes comparatively short, connivent beneath; antennæ short; first joint of the funicle subglobose, second rather longer, the rest transverse, gradually broadening into the ovate club; prothorax subtransverse, roughly granulate, ocular lobes feeble; scutellum raised; elytra nearly cylindrical, broader than the prothorax, the base shortly and abruptly sloping forwards, striate-punctate, punctures oblong, the interstices convex, finely granulate, posterior callus prominent; prosternum not emarginate; metasternum short; abdomen with the first suture obliterated, the conjoined segments very large and convex; femora with an acute tooth beneath; fore tibiæ short and curved; tarsi gradually broader to the third joint, which is strongly lobed, fourth joint elongate, its claws united at the base.

Euthycus incisus.

E. oblongus, niger; prothorace utrinque apicem versus linea profunda impressa instructo, disco fortiter bicanaliculato; elytris carinis alte elevatis munitis. Long. 6 lin.

Hab. India.

Oblong, black; rostrum rather long, stout, with numerous coarse, closely-set punctures; antennæ ferruginous, second joint of the funicle nearly twice as long as the first; club pubescent; prothorax longer than broad, rugose, having on each side a deeply incised vertical line near the apex, disk with two regular longitudinal grooves or canals; no scutellum; elytra twice as long as the prothorax, broadly rounded at the apex, the sutural margin raised as well as two lines on each elytron, which unite posteriorly and are more or less covered with short, yellowish, erect setæ, the intervals with coarse oblong punctures; legs moderately long; femora toothed; posterior tibiæ elongate, curved.

In size and outline like *Plinthus porcatus*, but with a peculiarly sculptured prothorax &c. I have placed it with *Euthycus* rather than with *Plinthus*, on account of the oblique

scrobes directed to the lower margin of the eye. The type is *E. macilentus* (Ann. Mus. Civico de Genova, ser. 2, vol. ii. p. 220, tav. i. fig. 6).

Exætoderes.

Caput latum ; *rostrum* perbreve, capite angustius ; *scrobes* ante oculos desinentes. *Oculi* rotundati, grosse granulati ; *scapus* antennarum pone oculum extensus. *Prothorax* subtransversus, lobis ocularibus nullis. *Elytra* convexa, prothoracis basi ibi haud latiora. *Femora* mutica ; *tibiæ* inermes ; *tarsi* tenues, articulo penultimo haud lobato. *Pectus* breve. *Episterna* metathoracica elytris cælata, segmentum basale abdominis vix ampliatum.

This genus wants two or three of the characters assigned to the Tanyrhynchinæ by Lacordaire, notably of the rostrum and tarsi ; the former is very short and broad and the latter are nearly filiform, the claw-joint being received in a cavity of the preceding.

Exætoderes scabripennis.

E. subellipticus, tomento pilisque griseo-brunneis omnino tectus ; elytra elongato-cordata, lineis elevatis tuberculatis munita. Long. 6 lin.

Hab. Capetown.

Clothed with a uniformly greyish tomentum and paler approximate hairs. Head broad and convex in front ; rostrum much shorter and marked off by two oblique, slightly impressed lines ; antennæ ferruginous, pubescent ; funicle with the first joint nearly as long as the two next together ; prothorax as long as broad, constricted anteriorly, the sides then rounded and covered with minute granules, each tipped with a recumbent hair, the middle with a short black line ; scutellum not apparent ; elytra oblong-cordate, each with seven more or less elevated tuberculate lines ; tubercles small, many of them tipped with a hair much longer than those elsewhere ; tibiæ straight, dilated at the apex.

Alcides gallus.

A. oblongus, nitide rufo-castaneus ; rostro elongato, subtiliter punctato ; prothorace granulato, in medio carinula lineare munito ; elytris postice gradatim angustioribus, striato-punctatis, interstitiis subtransversim impressis. Long. 4 lin.

Hab. Saylee.

Oblong, glossy reddish chestnut ; rostrum slender, nearly twice as long as the prothorax, minutely punctured ; antennæ

pitchy, scape rather short, second joint of the funicle longer than the first; prothorax with darker irregular granules, the intervals with narrow silaceous scales, a narrow, raised, median line throughout; scutellum small, black; elytra gradually narrower from the base, a little depressed behind the scutellum, striate-punctate, punctures nearly contiguous, the interstices somewhat transversely impressed; body beneath and legs sparsely covered with minute silaceous scales; fore tibiæ very slightly bisulcate.

In this species there is on the prothorax a well-marked median line continuous throughout; the depression behind the scutellum on the elytra is more circumscribed than on the following species.

Alcides tetanicus.

A. oblongus, nitide rufo-castaneus, parce silaceo-setosulus; rostro valido, versus apicem latiore, tenuiter punctato; prothorace granulato, ad apicem carinula lineare munito; elytris postice gradatim angustioribus, striato-punctatis, interstitiis subtiliter punctatis. Long. 6 lin.

Hab. Saylee.

Oblong, glossy reddish chestnut, sparsely covered with small silaceous setæ; rostrum stout, broader at the apex, finely punctured; antennæ rather short, second joint of the funicle not longer than the first; prothorax slightly convex, granulate, a raised line at the apical half; scutellum black; elytra gradually narrower from the base, the anterior part depressed, linearly punctured, punctures small, round, the interstices broad, with a few granules at the base; body beneath sparsely covered with minute silaceous scales; fore legs of moderate length, their tibiæ very slightly bisinuate; anterior coxæ approximate.

At once distinguished from the preceding by its stout rostrum; the fore legs are comparatively short, the body at the shoulders is of considerable breadth, and the elytra towards the apex are much more markedly narrowed.

Alcides censorius.

A. oblongus, nigro-piceus, subtiliter parce griseo-pilosus; rostro elongato, tenuato, parte basali solo remote punctato; funiculo articulo secundo breviusculo; prothorace granulato; elytris striato-punctatis, interstitiis rude granulatis. Long. 6 lin.

Hab. Ceram.

Oblong, pitchy black, covered with a thin greyish pilosity; rostrum elongate, slender, the basal part only distinctly punc-

tured; antennæ black, second joint of the funicle shorter than the first; prothorax closely granulate; scutellum roundish; elytra convex, gradually narrower from the base, the anterior part slightly depressed, striate-punctate, punctures coarse, approximate, the interstices covered with irregular granulations; body beneath rather closely covered with small whitish scales; fore legs elongate; tibiæ slightly bisinuate.

It is only under a strong lens that the real sculpture of the elytra is seen; to the naked eye they seem minutely punctured in close regular lines. So far as the facies is concerned this species may follow *A. decurvus*.

Alcides vestitus.

A. cylindricus, niger, plerumque dense albido-pilosus, setulis interjectis; rostro tenuato, basi confertim punctato; prothorace granulato; elytris modice convexis, lateribus parallelis. Long. 5 lin.

Hab. Banda.

Rather narrowly cylindrical, black, covered with large patches of a close-set whitish squamosity, studded with hair-like setæ; rostrum slender, twice as long as the prothorax, the base with crowded punctures; antennæ pitchy, second joint of the funicle longer than the first; prothorax nearly as long as broad, the middle of the disk bare and closely granulate, the sides densely covered with whitish scales; scutellum subquadrate; elytra moderately convex, parallel at the sides, on each a bare oblique stripe in the middle, the rest with a dense covering of whitish scales; body beneath densely covered with minute yellowish scales; fore tibiæ strongly bisinuate.

The close-set whitish or yellowish-white scales or squamosity, studded with hair-like setæ, nearly covering the whole upper surface of this species, will at once differentiate it from any of its congeners. In the above four species the femoral tooth is very distinctly denticulate.

Alcides nitidus.

A. oblongus, glaber, nitide chalybeatus, supra squamulis albis maculatim ornatus; rostro elongato, tenuato, fere recto, subtilissime punctato; prothorace leviter punctato; elytris punctis parvis seriatim instructis. Long. 4–5 lin.

Hab. Batchian, Waigiou.

Oblong, smooth, glossy steel-blue, more or less spotted with masses of white scales; rostrum slender, elongate, nearly straight, minutely punctured; antennæ pitchy, funicle elon-

gate, the two basal joints equal in length; prothorax with small remote punctures; scutellum roundish; elytra seriate-punctate, punctures small, remote, the interstices broad, flattish, each elytron with a white spot near the scutellum, three or four behind the middle, or connected so as to form a band, and two near the apex; body beneath smooth, the sterna more or less covered with close-set whitish scales; legs slender; anterior tibiæ very slightly bisulcate.

One of my specimens has the three intermediate abdominal segments margined with close-set white scales and an additional white spot near the base of each elytron. This species is somewhat remarkable in having the rostrum extremely minutely punctured at the base as well as beyond to the apex.

Alcides geminatus.

A. oblongus, fuscus, lineis griseis e pilis condensatis ornatus; rostro piceo, elongato, tenuato, apice dilatato; prothorace inæqualiter punctato, granulis parvis intermixtis; elytris rude striato-punctatis. Long. 3½ lin.

Hab. Java.

Oblong, dark brown, with a few lines of greyish hairs; rostrum pitchy, elongate, slender, much broader at the apex; antennæ ferruginous, the second joint of the funicle shorter than the first; prothorax irregularly punctured, with a few granules between the punctures, the disk with two narrow greyish stripes and one on each side; scutellum roundish; elytra nearly parallel at the sides, with linear punctured striæ, punctures subquadrate, the interstices rugose, each elytron with an elongate, oblique, slightly flexuous stripe proceeding from the shoulder, and a shorter oblique apical stripe directed towards the suture; body beneath with scattered scales, except on the sterna; anterior femora slender, their tibiæ slightly bisulcate.

Very near *A. intrusus*, but with a slender elongate rostrum, and more slender but scarcely longer antennæ, and the prothorax with two lateral instead of one median line on the disk &c.

Alcides Oberthürii.

A. obovatus, fuscus, capite, rostro antennisque piceis; elytris striatis, striis setulis silaceis repletis, interstitiis granulis nitidis planiusculis confertim instructis. Long. 4 lin.

Hab. India *.

* I owe my specimen to M. René Oberthür. The habitat given on his ticket is "Indes Orientales, Mts. Kodeicanel." I cannot find this name in Keith Johnston's large atlas. I believe, however, that they are in Southern India.

Obovate, brown; head, rostrum, and antennæ dark pitchy brown; rostrum stout, nearly straight, a little longer than the prothorax, remotely punctured throughout; second joint of the funicle considerably shorter than the first; prothorax with rather large, flattish, and occasionally confluent granules, the interspaces finely setulose, the sides with close-set scales, trifid at the apex; elytra gradually broader behind, striate-punctate, the striæ filled with silaceous hair-like scales, the interstices with large, flattish, approximate granules; body beneath covered with greyish scales; legs comparatively short, the tooth on the femora not denticulate.

The elytra broader behind and their striæ filled with silaceous scales, forming well-defined lines alternating with the glossy interstices, will at once differentiate this very marked species. The scutellum is not to be distinguished from the surrounding parts.

Alcides collaris.

A. breviter ovatus, niger, nitidus, prothorace rufo-castaneo elytrisque albo-bifasciatis; femoribus dente parvo integro instructis. Long. $3\frac{1}{2}$ lin.

Hab. India.

Shortly ovate, glossy black, the prothorax reddish chestnut, and the elytra with two white bands of close-set scales; rostrum stout, shorter than the prothorax, gradually broader towards the apex, not curved, and approximately punctured throughout; antennæ pitchy, short, stout, first joint of the funicle twice as long as the second; prothorax somewhat globose, with large, flattish, crowded granules, each with a minute white scale behind, the middle with a few punctures; scutellum small but distinct; elytra slightly narrower from the base, with large subapproximate punctures, the interspaces smooth, a transverse series of nearly united spots at the base, and just behind the middle a flexuous band, not meeting at the suture; body beneath glossy black, with patches of white scales; legs comparatively short; the anterior femora armed with a slender spiniform tooth, their tibiæ moderately bisinuate.

The species of *Alcides* here described have bifid claws and elytra not, or scarcely, broader than the prothorax; the latter more or less transverse, with the sides behind the contracted apex rounded, except at the base. In all the species of this large genus (I have about 140) the funicle is only six-jointed, and the base of the prothorax is deeply bisinuate, the scutellar lobe especially advancing considerably between the elytra.

Baris cælestis.

B. elliptico-ovata, læte cærulea vel violacea, antennis tarsisque nigris; rostro modice elongato, basi constricto; elytris profunde striatis, interstitiis planatis, uniseriatim punctatis. Long. 3 lin.

Hab. Delagoa Bay.

Elliptic-ovate, clear blue or violet, antennæ and tarsi black; head finely punctured; rostrum rather elongate, the base compressed and coarsely punctured, beyond glossy black, with finer punctures; prothorax transverse, slightly concave, closely and coarsely punctured; scutellum equilaterally triangular, with the apex towards the prothorax; elytra narrowly striate-punctate, the striæ blackish, with greenish specks between the punctures, interstices flat, each with a row of rather marked punctures; body beneath and legs punctured, each puncture bearing a short white hair; tarsi with the three basal joints gradually broader.

This species belongs to Schönherr's first "stirps," *i. e.* those species with stout antennæ. The colour varies a little according to the light. The form of the scutellum is peculiar.

Baris eburifera.

B. cylindrica, atra, opaca; elytris maculis sex albis basalibus munitis; rostro fortiter striato-punctato; pedibus ferrugineis. Long. $1\frac{1}{2}$ lin.

Hab. India?

Cylindrical, opaque black, elytra with six spots at the base, formed of tufts of white or cream-coloured scales; rostrum stout, not longer than the prothorax, curved, closely punctured between slightly elevated longitudinal lines; antennæ ferruginous, short, stout, the funicle gradually thickening into the club; prothorax nearly as long as broad, bisinuate at the base, closely punctured; scutellum small, triangular; elytra parallel for about half their length, then gradually rounded to the apex, striate-punctate, punctures oblong or shortly linear, interstices slightly raised; legs dark ferruginous, with sparse greyish scales.

This species has lately occurred in hothouses in England, imported with orchids from India or the East. It is one of the smaller kinds, like *B. morio*, but peculiar for its tufts of close-set white scales on the elytra, to the naked eye resembling little ivory points.

Acythopeus genuinus.

A. ovatus, niger, opacus; rostro basi haud gibboso; prothorace

utrinque rotundato, sat fortiter punctato, punctis inter se separatis; elytris interstitiis subtiliter granulatis. Long. $2\frac{1}{2}$ lin.

Hab. Malaisia.

Ovate, black, opaque; rostrum not gibbous at the base, coarsely punctured, the punctures uniformly separated; antennæ black, the club ovate; prothorax transverse, rounded at the sides, not narrowed at the base, and comparatively coarsely punctured, the punctures approximating but distinctly separated; scutellum nearly round; elytra narrowly striate, the interstices flat and minutely granulate, the granules few and in a somewhat irregular line; pygidium very short; body beneath and legs sparingly punctured, each puncture with a short silver hair.

Some time ago I received several specimens of this species from G. Saunders, Esq., in whose conservatory at Tunbridge Wells they were found in the stems of certain orchids; like its congeners its habitat is probably some island of the Malay Archipelago. It differs from *A. tristis* (Linn. Soc. Journ. xii. p. 62, pl. iii. fig. 2) in the form and sculpture of the prothorax, the granulate interstices of the elytra, &c. Mr. C. Waterhouse has described another species (*A. aterrimus*, Ent. Month. Mag. vol. x. p. 226) closely allied to both, but differing in sculpture, the latter having the rostrum furrowed at the sides, the prothorax with glossy granules on the interspaces between the punctures, &c.

Acythopeus funereus.

A. ovatus, niger, opacus; elytris basi singulatim macula parva alba notatis; rostro basi fortiter gibboso; oculis infra connexis; elytris interstitiis transversim sulcatis. Long. $2\frac{1}{2}$ lin.

Hab. Tondano.

Ovate, black, opaque, a small white spot on each elytron at the base; rostrum compressed and strongly gibbous or raised at the base, and roughly granulate, the rest smooth, glossy black, and nearly impunctate; prothorax moderately transverse, closely punctured; scutellum indistinct; elytra narrowly striate, the interstices flat and transversely sulcate; pygidium short; body beneath and legs studded with silvery hairs.

In facies like the last, but at once differentiated by its gibbous rostrum, the eyes confluent beneath, sculpture of rostrum and elytra, &c. The transverse grooves on the interstices of the elytra are apparently composed, at least in some places, of two partially connected punctures.

Lystrus longimanus.

L. trapezoideus, fusco-niger, parum nitidus; antennis ferrugineis; rostro dimidio basali lineis elevatis instructo; pedibus anticis valde elongatis, tibiis eorundem fortiter arcuatis. Long. $2\frac{1}{2}$ lin.

Hab. Sumatra.

Trapezoidal, brownish black, slightly glossy, antennæ ferruginous; rostrum moderately long, basal half with raised lines, the intervals punctured; antennæ with the club as long as the funicle; prothorax rapidly broader to the base, with close-set granules in short transverse lines; scutellum round; elytra narrowly striate, the interstices broad, with contiguous punctures; body beneath densely covered with pale greyish scales; intermediate and posterior legs very short, ferruginous, the tibiæ of the former with a tooth on the outer edge at the base; fore legs very long, their tibiæ strongly curved, their tarsi of moderate length.

A broader species than *L. latipennis* (Linn. Soc. Journ. xii. p. 44, pl. iii. fig. 1) and differently sculptured. It is possible that the remarkably long anterior legs may be a sexual distinction, at least to a certain extent.

L.—*On the Phylogeny and Anatomy of the Echinodermata.* By Dr. Otto Hamann *.

1. *Origin of the Echinodermata.*

If we set before us the question to what group of the Metazoa, with reference to the whole of their peculiarities of organization, are the Echinodermata most nearly related, the answer will serve at the same time to throw light upon their phylogenetic origin. I have said if we take into consideration "the whole of their peculiarities of organization," and therefore the constitution of the nervous system, the body-cavity, &c., and would thereby indicate that I must regard as failures all the attempts which look only to a single system of organs, such as has lately been made by Kleinenberg, who, by taking into consideration only the nervous system, has been led into the most wonderful speculations as to the origin

* The concluding chapter of a memoir on the Histology of the Echinodermata, translated from the 'Jenaische Zeitschrift,' Band xxi. pp. 232–251.

of the Annelida from Medusæ, speculations and ideas which can hardly find confirmation in nature. The larval forms of the Echinodermata, the formation of the body-cavity, the enterocœle, the origin and structure of the nervous system, will chiefly point towards worm-like creatures, and indeed to *such forms as possess a typical enterocœle of like origin and development*, and in which the nervous system is either still situated in the ectoderm, as in the Asterida, or arranged in the same way as in the Echinida and Holothuriæ. To ascribe to the Echinodermata a near relationship to the Cœlenterata, as has been done by Kleinenberg, although certainly only in a remark *en passant* *, will not do, for the agreement in the structure of the nervous system alone would not suffice to balance the great number of other differences of structure, as, for example, the existence of a body-cavity in the Echinodermata.

Among the groups of Vermes the Annelida, with their typical enterocœle, stand nearest to the Echinodermata, as Häckel has long since shown; and, in fact, this notion is most particularly well supported, especially by the structure of the body-wall. In the Asterida there is in each arm a dermal muscular tube, consisting of a layer of annular and a layer of longitudinal muscles. In the Echinida the former exists only in a rudimentary form (Ludwig), while in the Holothuriæ it appears to be confined to definite zones.

As regards the structure of the nervous system, it is as simple as is conceivable in Asterida, consisting of epithelial sense-cells and nerve-fibres. But among the Vermes also, and, indeed, among the more highly developed of them, we find forms in which the whole nervous system persists throughout life in the ectoderm. This is the case in the Archannelida (Hatschek and Fraipont).

There is consequently no reason to prevent us from regarding the Echinodermata, although not as Annelida, yet as descending from Vermes provided with true body-cavities, in which the nervous system still remained in the lowest stage of development and in which a water-vascular system was probably already developed. But then the first question is, What group of Echinodermata is to be regarded as the earliest, and are the different divisions deducible from each other?

It is remarkable that the majority of zoologists and geologists regard the Crinoidea (or Cystidea) as those which have retained all organizational characters in their most primitive condition.

* Zeitschr. für wiss. Zool. Bd. xliv.

Crinoidea and Asteroidea are of the same antiquity. Both groups make their appearance as early as in the Silurian formation. But the species which here first come under our notice are such as can by no means pass as primordial forms. These have not been preserved for us. This becomes intelligible if we consider that in them the calcareous skeleton, and therefore the parts best adapted for preservation, will have been still but scantily developed, and that in general all the remains of Asterida appear to be very badly preserved, so that they generally occur only in fragments. Hence we cannot expect that palæontology will ever elucidate the phyletic history of this group. This opinion, which has also been expressed by Zittel (Handb. der Pal. i. 1, p. 309), has not been adopted by other palæontologists, such as Neumayr*, but they have established a genealogy of the Echinida almost exclusively upon palæontological data. Whether this genealogy is reconcilable with the anatomical data is a matter which I will briefly discuss.

According to Neumayr the Cystidea are to be regarded as the stock-group of the Echinodermata, therefore a group which others have united with the Crinoidea, and from them the Crinoidea are supposed to have branched off. This branching off is no further demonstrable, as both groups make their appearance side by side in the Lower Silurian, and earlier remains have not yet been found. The assumption that the Cystidea are the most ancient Echinid group has therefore not even a palæontological foundation. Further, according to Neumayr, the Ophiuroasterida have branched off from the Cystidea, and the Echinida in another direction. Other naturalists have already raised the question whether, if certain forms of Cystidea, such as *Agelacrinus*, remind us of the Asterida, this is not due to mere accidental external resemblances. The same applies no doubt to the resemblances which have been found between Cystidea (such as *Mesites*) and Echinida. As Hörnes says†, the genetic relations here are still very doubtful.

If we add to this that important objections have been raised against the homologization of the basal plates of the Crinoidal calyx with the apical plates of the Echinida (H. Carpenter), the probability of the derivation of the Echinida from the Crinoidea is still further diminished.

To all this must be added, and this gives the finishing

* "Morphologische Studien über Echinodermen," in Sitzungsb. d. k. Akad. Wiss. in Wien, Bd. lxxxvi. (1881).

† 'Elemente der Paläontologie,' 1884, p. 173.

stroke, that anatomically and histologically it is impossible to accept the Crinoidea as the stock-group of the Echinodermata. Our present standpoint can only be that on the one side stand the Crinoidea and on the other the Asterida, from which the Echinida may be derived without any difficulty, and lastly the Holothuriæ. While the last-mentioned three groups can be derived, in their organization, from one another, the Crinoidea stand without any connexion.

Quite peculiar and present in no [other] group are the remarkable calycine pores, through which the body-cavity communicates with the outer world. Above all, however, the nervous system is not in the primitive form which occurs in the Asterida. This (the nervous ring and ambulacral nerve-stems radiating from it) is no longer situated epithelially, but subepithelially (Ludwig). The most important part of the nervous system of the Crinoidea is, however, placed dorsally, in the centro-dorsal plate; from a central organ fibrous cords are given off into each arm, and from these similar cords to the muscular fasciculi and appendages of the arms, as already described by W. B. Carpenter in 1865. A dorsal nervous system so constructed does not occur in the Asterida (Ophiuri), Echinida, or Holothuriæ.

We have also to consider above all the body-cavity of the Crinoidea, which is probably to be regarded as a schizocœlar cavity, and the sexual organs, the structure of which differs from that of those of the other groups.

I think, therefore, that the Crinoidea may be most naturally regarded as a lateral branch of the Echinodermata, about the origin of which we are still in doubt. As coming nearest to the truth we may perhaps suppose that the Crinoidea and the Asterida have sprung from a common root. I regard the latter as the stock-form of the most nearly allied Echinodermata, referring especially to the structure and ectodermal position of the nervous system. How I suppose the Echinida to have originated from them will be shown in the following pages.

Consequently I come to the conclusion that those naturalists, with Häckel, G. O. Sars, and Lange at their head, who place the Asterida at the head of the Echinodermata, have hit upon the right course. Palæontology, it may be repeated, supports neither the one interpretation, according to which the Crinoidea are to be regarded as the most ancient class of the Echinodermata, most nearly approaching the stock-group (Claus), nor the other view, just maintained by me, as the two groups make their appearance together at the same time

in the Lower Silurian. The morphological data alone can be appealed to here for the decision of the question.

2. *The Relationship between Asterida and Echinida.*

Having described the organizational characters of the Echinida, I may attempt in what follows to bring together the reasons which give the greatest possible probability to the proposition that the Asterida must be regarded as the primordial group most nearly approaching the stock-form of the Echinodermata, and the Echinida to be derived from them, as has already been supposed by Häckel, Gegenbaur, and others.

I know very well that with many this assumption passes as an established proposition. For such what follows is written only to a limited extent, so far as they, unlike myself, are of opinion that this proposition is still unproven. I would also further show that it is only possible to explain the organizational characters of the Echinida if we derive them from those of the Asterida, and that this assumption alone admits of an unforced explanation of their structure.

Palæontology shows us that the Asterida are among the most ancient of organisms, and that there is nothing to prevent the Echinida, which are already represented in the Lower Silurian, being derived from them. Of course in this we have to consider only the regular Sea-urchins, but not the irregular ones, such as the Spatangidæ, which may with great certainty be regarded as later formations. Hence, when in what follows I speak of Echinida, it is especially only the regular Sea-urchins that I refer to.

In deriving the Echinid-organism from that of the Asterida, the *nervous system* must be taken into consideration in the first place. In the Starfishes the nervous system originates in the ectoblast *, and retains its position in the ectoderm. This applies to the central nervous system, the cerebral ring, and five (or more) ambulacral nerve-trunks. The intestinal nervous system I leave on one side, as not essential in our comparison.

In the Echinida, when the animal is mature, the nervous system is no longer situated in the ectoderm; it has come to lie in the mesoderm; and in them we find it connected with the epithelium of the body only where sense-organs are present.

But are the elements which constitute the central nervous

* See Ludwig, *Asterina gibbosa*.

system in the Echinida the same as those of the Asterida, or derivable from those of the latter group? To decide this question we may refer briefly to the constitution of the nervous system of the Asterida. The cerebral ring and the ambulacral nerves consist of nerve-fibres intermixed with ganglion-cells, which run between the processes of the unusually elongated, filiform, epithelial cells of the ambulacral groove. These epithelial cells I have named "supporting-cells," and their basal processes "supporting-fibres;" the latter are the so-called transverse fibres of older writers, which run perpendicular to the nerve-fibres. In the Echinida the central nervous system consists of the following elements:—the nerve-fibres with the ganglion-cells, and, applied to these, cells the nature of which may be a matter of dispute. This coating of cells, which lies peripherally upon the main nerve-stems and the central ring, is regarded by Frédéricq as nervous—it is supposed that we have here to do with ganglion-cells which lie upon the cords of nerve-fibres in the same way as is the case in many Vermes, for example.

Whether these cells have acquired the function of ganglion-cells seems doubtful to me. Judging from their origin *they are epithelial cells which have come to lie in the mesoderm together with the nerve-fibres originally* (*in the ectoblast*) *epithelially situated and produced.* In the first place they function as a covering epithelium, a protective coat for the fine nerve-fibres, as I have already shown in the Holothuriæ, and as seems to me to follow pretty certainly from a comparison with the Asterida.

That these cells form a covering epithelium, a protective covering, appears further from *their basal supporting-fibres, which traverse the nerve-fibres perpendicularly.* These supporting-fibres have, however, hitherto escaped the notice of naturalists in the Echinida. I believe that even those who are inclined to interpret the covering-epithelium as of nervous nature can no longer, after the discovery of the supporting-fibres, uphold this opinion to its full extent. But what further goes against the nervous nature of these cells is their difference in form and size from the true nerve-cells in the main trunks, and the nerve-cells which form a peripheral coating at the point of bifurcation of the main nerve-cords.

The ganglion-cells which are situated in the main trunks and the cerebral ring possess an oval nucleus, which always stains of a lighter colour than the nucleus of the covering-cells. A nucleolus is usually to be seen. The size of the ganglion-cells is different from that of the covering-cells.

The latter are always smaller and generally possess a basal cell-process, a direct continuation of the cell-substance, which shows a different refractive power from the nerve-fibres, and therefore, if only on that account, has nothing to do with them, and, further, is much stronger and has a greater diameter.

The ganglion-cells, as they occur in the peripheral parts of the nervous system, are of two different forms. If they lie within the nerve-fibres, the nerves of the skin (I am referring to nerve-cords), they have the same form as in the main trunks. Besides this kind cells occur which are characterized by their size, their large pale nuclei, and their constantly distinct nucleoli. These lie peripherally upon the nerve-cords, and where nerve-fibres issue from the nerve-cords, for example to run to the muscular fibres (in the pedicellariæ the ramifications between the musc. adductores, in the basal annular nerve of the spines of *Sphærechinus*, *Echinus*, *Centrostephanus*, &c.), form a coating between the muscular fibres embraced by the nerve-fibres. These cells measure about 0·07 millim., and their circular nuclei 0·002–0·003 millim. That they differ widely from the cells of the covering-epithelium there can be no doubt.

If I have discussed the question of the interpretation of these coating-cells in a detail which may appear superfluous to many, this is due to the wish to render my description as conclusive as possible.

If we are to derive the Echinida directly from the Starfishes, we must seek in them for organs homologous with *the tentacle* and *eye-spots*. As is well known there are upon the intergenital plates (ocellar plates) in many Sea-urchins pigment-spots which it has been supposed might be interpreted as eyes, seeing that they are situated in spots homologous with the ends of the arms of Starfish. As I have already shown, we have to do here by no means with structures resembling the eye-spots of Starfishes, but only with accumulations of pigment which may sometimes be present, sometimes absent. But that we may in this case with some justice speak of degenerations of the eye-spots appears from the presence of a tentacle, although a modified one, in the Echinida *. The tentacle pierces the intergenital plate, and thus comes to lie partly in and partly upon the latter. A water-vessel (ambulacral) and a nerve-trunk terminate in it in the same way as in the Starfishes. Nay, even mobility cannot be wholly denied to the Echinidan tentacle, seeing that it, or

* See Hamann, "Vorl. Mitth. zur Morphol. der Echiniden, No. 5," in Sitzungsb. der med.-naturw. Gesellschaft zu Jena, 1886, Heft 2.

at least its terminal portion which rests upon the plate, can very well be inflated by the water-vessel which terminates cæcally in it, and in this way may be pushed forth, though only to a limited extent. Perhaps Sea-urchins still exist in which there are eye-spots like those of the Starfishes, and in which the resemblance of the tentacles of the two groups will be still greater. This, however, appears to be doubtful, inasmuch as, where true organs of vision are at present known in Sea-urchins, these have been found upon the surface of the test, where, especially when present in great number, they must be of essential service to the animals *.

Of equal importance for the question of the derivation of the Echinida from the Asterida is a *comparison of their sanguiferous spaces*, i. e. *the whole of the schizocœle structures.*

In the Starfishes there is in the body-wall a system of lacunæ and hollow spaces, which have been in part described as perihæmal spaces (Ludwig). All these lacunæ and spaces are gaps in the connective substance, schizocœle-spaces, as I have demonstrated in opposition to the previous supposition that they are parts of the enterocœle, by tracing their origin. In the ventral wall such a schizocœle-space runs into each arm. We find them again in the Sea-urchins in each ambulacrum, and here likewise terminating cæcally, in this case by the intergenital plate, in the former (Starfishes) by the tentacle. But while in the Starfishes these five spaces or canals unite in the centre to form an annular canal, which is connected through the tubular canal with the schizocœle-spaces in the dorsal body-wall, the conditions are different in the Echinida, seeing that in them a masticatory apparatus has been developed (probably from vertical plates), and the tubular canal occurs only as a rudiment. Moreover, in the Sea-urchins there is retained only a remnant of the schizocœle-system of the dorsal wall of the Starfishes, in the form of the *schizocœlar anal ring*, as I have already shown †, from which structures lead to the sexual organs, like those presented by the Starfishes. That all these phenomena may be easily explained by the origination of the Sea-urchin from the Starfish is perfectly clear, while the reverse mode of origin seems almost inconceivable, or, at any rate, is less probable.

In the five schizocœle-spaces (longitudinal canals) of the ventral wall ("perihæmal spaces" of Ludwig) of the Asterida connective partitions (septa) have, as is well known, been developed, and in these formation of unwalled spaces (the blood-lacunæ) has taken place.

* See Sarasin's statements, Zool. Anz. 1885.

† See also my "Vorläufige Mittheilungen," already quoted.

That we find the ventral longitudinal canals of the Asterida again in the Echinida I have already shown.

But what we do not find in the Echinida (and Spatangida) are the septa, the longitudinal partitions of the ventral longitudinal canals with hollow spaces developed in them, the true blood-lacunæ. This may be explained in the following way: In the Asterida, as the more ancient forms, the central nervous system remains throughout life in the ectoderm, where it originated, while in the Echinida at a certain time it separates from the ectoderm and moves into the longitudinal canals. In the Sea-urchins the longitudinal canals (*i. e.* the canals indicated as perihæmal spaces in the Starfishes) are traversed throughout their whole extent by the five ambulacral or radial nerve-trunks. By this means of course a development of partitions or septa is rendered impossible. If we speak of perihæmal canals in the Starfishes, in the Sea-urchins we must call them perineural canals.

These perineural canals have no connexion at all with the system of blood-lacunæ. The lacunar ring, which in the Starfishes runs round the œsophagus, has in the Echinida come to be situated upon the lantern, and from it start the lacunæ to the intestine and the glands.

In schizocœle-formations of the back the blood-lacunæ run, in the same way as in the Asterida, in septiform structures. Moreover the Asterida and Echinida exhibit similar structures in the blood-lacunæ running to the sexual organs.

In Starfishes a schizocœle-space runs to each sexual organ and is continued in lacunæ of the connective substance of the wall of the organ. But in each schizocœle-space there runs also in the suspensory band a blood-vessel (according to Ludwig's designation), which is connected with the glandular organ. I regard these canaliculi also as conductive lacunæ for the glandular organ. The cells in them will certainly have taken up materials from the sexual organs to be conveyed towards the glandular organ. That excretory materials are found in the lacunæ of the wall of the sexual organ may be easily proved by sections. Deposits of granules, sometimes of a brownish, sometimes of a yellow colour, occur everywhere. Nay, it has even been said by one naturalist that the sexual organs, at the time when they do not form ova or semen, function as glands!

In the Echinida the anatomical character is the same. In them also schizocœle-spaces pass to the organs and enclose the peculiar lacunæ situated in the walls. The foundation of the sexual organs is the same in both groups. Nay, the figures which show the sexual organ in the Echinida still in

the form of an oval vesicle projecting into a vacant space (schizocœle-space) might equally well be drawn from a Starfish.

In Asterida a follicular epithelium could be demonstrated. In Echinida the first foundation of the ovicell from epithelial cells is so far the same that here also a commencement of follicle-formation is made. It goes no further, however, and the developed Echinidan ovum possesses a resistant envelope, which, however, has been formed from the ovicell and not from a follicular epithelium.

An apparently great difference in the organism of the Sea-urchin is constituted by the presence of a special masticatory apparatus, the lantern. That this is produced by alteration and transformation from whorls of the Starfish seems to be probable. But that no Starfish can be produced from a Sea-urchin provided with a masticatory apparatus is shown with certainty, in my opinion, by the position of the oral blood-lacunar ring and of the water-vascular annular canal. The peculiar positions of these organs in Echinida are in relation to their simpler and more easily intelligible position in the Starfish under the condition of the changed position of the whorls.

A further important agreement is shown by the *water-vascular system*. The stone-canal of the Asterida is of very complex structure and forms a smooth-walled tube only in youth. Later on spiral convolutions of various forms appear in the lumen. In the Echinida the canal remains a smooth tube and shows no organization indicative of the structures occurring in Starfishes. This retrogression, as I conceive the simplicity of this organ in the Echinida to be, is closely connected with the mode of life of these animals. Their movement is in most cases limited in extent. The sucking-feet are only moderately effective, owing to the long spines, and locomotion takes place usually with the aid of the spines employed as stilts. Through this a retrogression of the longitudinal canals (ambulacral vessels) of the aquiferous vessels has taken place; the ampullæ are less developed, and the valves occurring in Asterida have disappeared. In their place the transversely-stretched muscular threads provide for the closure of the ampullæ, but of course only in a very insufficient manner. Most of the ambulacral feet are therefore but little developed, and this applies particularly and in a still greater degree to the Spatangidæ, in which the retrogression has gone much further.

In two or three words I must refer to the disappearance of the musculature of the body-wall in the Echinida. In the

Starfishes I have demonstrated in the body-wall of each arm an annular and a longitudinal muscular layer, such as exist in the same way in the Vermes. In the Echinida the rays (the arms) are amalgamated with the body, the calcareous secretions form a skeleton consisting of ten pairs of plates, for which muscles in the body-wall have become unnecessary. If, then, we assume that the Holothuriæ have branched off from the Echinida, this must have occurred early, that is to say they must have originated from forms in which the musculature had not yet retrograded nor the skeleton been developed, as is the case in existing Echinida. According to Ludwig's * discovery in Spatangidæ, on the dorsal surface between the rows of plates situated above the periproct there are muscular fibres at the point where they meet in the middle line. This musculature, which consists of short (1 millim. long), smooth, muscular fibres, notched at their extremities, is to be regarded as the remnant of the annular (and longitudinal) musculature of the body-wall, such as is shown by the Starfishes.

3. *What Structures are we to regard as Sanguiferous Spaces in the Echinodermata?*

The older naturalists supposed that in the Asterida the five or more longitudinal canals running in the ventral surface of the arms were the blood-vessels, and that the annular cavity surrounding the œsophagus, which unites these five or more canals, was the annular vessel. It was shown, however, by Lange and Teusch, that these radial or ambulacral longitudinal canals were divided in their whole length by a vertical band, and that this band in its whole extent was traversed by interstices and cavities. In the latter they recognized the true blood-vessels, or rather blood-lacunæ. That the conditions are the same in the dorsal body-wall, and that here also the true blood-lacunæ (the anal ring of blood-lacunæ and the lacunæ leading to the sexual organs) lie in such canals, has been shown by Ludwig, who proposes the name of *perihæmal canals* for the latter. At the same time, however, that naturalist supposed that the perihæmal canals were in connexion with the body-cavity, the enterocœle. I have shown, by demonstrating the origin of these canals as also of the ventral blood-lacunæ, that perihæmal cavities as well as blood-lacunæ of the septa or suspensory bands are schizocœle-formations and therefore homologous structures. This applies also to the cavitary system dis-

* "Ueber bewegliche Schalenplatten bei Echinoideen," in Zeitschr. für wiss. Zool. Bd. xxix.

covered by Greeff in the connective substance of the cutis of the dorsal wall. These cavities are connected with the perihæmal spaces and the so-called tubular canal.

Taking all this into consideration we have in the Asterida a series of schizocœle-structures to which the five or more ventral radial canals (perihæmal spaces) belong, and, further, the blood-lacunæ running through septa, likewise schizocœle-cavities.

What do we find of these two systems of cavities in the Echinida?

In the regular Echinida we find the five longitudinal canals, in which the five ambulacral or radial nerve-trunks have come to lie. Further, we find a cavity enveloping the annular nerve at one of its surfaces, a homologue of the annular perihæmal cavity in the Asterida. Besides these we have to note an anal annular schizocœle-cavity, with cavities which run to the sexual organs. These are the sole remains of the great dorsal canal-system of the Asterida; in their wall, *i. e.* in the wall of the anal schizocœle-cavity and partly projecting into it, lies the anal ring of blood-lacunæ, and, in the cavities running to the sexual organs, the blood-lacunæ. Consequently in the dorsal part of the Echinida the same conditions exist as in the Asterida. Here also we may speak of perihæmal cavities. The different character of the ventral surface is to be explained by the formation of the masticatory apparatus and by displacement of the five radial nerve-trunks, which have deserted their epithelial position and moved into the schizocœle-cavities. The septa with the blood-lacunæ (in the longitudinal canals), and therefore the true radial blood-lacunæ of the Asterida, have disappeared. But, on the other hand, a pericœsophageal ring of blood-lacunæ has become developed upon the lantern, and from this the blood-lacunæ run, as in the Asterida, to the gland, intestine, &c.

In the Spatangida, which are quite certainly to be derived from the Echinida, these conditions are as follows:—The masticatory apparatus has disappeared, and with it the pericœsophageal ring of blood-lacunæ situated upon it. In the five longitudinal canals (perihæmal canals) which open into an annular canal situated around the œsophagus lie the (radial) ambulacral nerve-trunks and the circumoral nerve-ring as in the regular forms. But the blood-lacunæ (dorsal and ventral) of the œsophagus open into this annular schizocœle-canal. This, consequently, in the Spatangidæ is to be regarded as a blood-lacunar ring, and the five longitudinal canals given off from it as the five ambulacral blood-lacunæ.

Thus in the Spatangida there has occurred a fusion of the cavitary systems, which in the Asterida are separate. In the dorsal part the blood-lacunæ run in the wall of the schizocœle-sinus, as I have shown for the first time. In this, therefore, these forms agree with the regular Echinida and the Asterida.

Let us now consider the Holothuriæ. In *Synapta* there is a blood-lacunar ring of very feeble construction running in the wall of the annular water-vascular canal. From this blood-lacunæ issue to the tentacular canals. In this genus no schizocœle-cavity runs through the five ambulacra. In the foot-bearing Holothuriæ, which show more primitive conditions, however, we again find the five radial ambulacral schizocœle-cavities; here they may justly be denominated blood-lacunæ.

In the Crinoidea we find radial longitudinal canals, which, as I propose to demonstrate immediately, are likewise schizocœle-structures, and are, certainly with justice, described as the radial blood-vessels by Ludwig. Greeff and Ludwig declared them to be homologous with the radial longitudinal canals (perihæmal cavities of Ludwig) in the Asterida. Subsequently Ludwig has retracted this opinion, because he thinks that the longitudinal canals of the Asterida are not themselves blood-lacunæ, but that the latter are situated in the septa, so that the blood-lacunæ of the Asterida and Crinoidea are quite different structures. The foundation of this opinion is to be found in the fact that Ludwig regarded the longitudinal canals as enterocœle-structures. When Ludwig further says that in the Crinoidea no perihæmal cavities have yet come into development, either in the periphery of the oral blood-vascular ring or in that of the radial blood-vessels, we may reply as follows:—The radial blood-vessels (so-called) of the Crinoidea and their oral blood-vascular ring are nothing but the radial longitudinal canals (perihæmal cavities) of the Asterida and their oral annular canal. But while in the Asterida special lacunæ, the true blood-lacunæ, have been developed in septa, the septa are wanting in the Crinoidea. The blood moves in the longitudinal canals, as is partially the case in Spatangida and Holothuriæ.

Further, the Crinoidea also possess other radial schizocœle-canals (homologous with the dorsal cavities of the other Echinodermata), and in these (in septa) blood-lacunæ occur, as will hereafter be shown in detail.

Summing up briefly all these conditions, it appears that no decided difference exists between true blood-lacunæ, situated

in septa which are extended in the radial schizocœle-cavities and the latter themselves; both structures are schizocœle-structures, and originate as spaces and cavities in the connective substance. To this must be added that the young *Asterias* of perhaps a centimetre in diameter has no cavities in its septa of the ventral surface, but that in this case the longitudinal canals (perihæmal cavities) must rather function as sanguiferous spaces. In future, when we speak of the blood-lacunar system in the Echinodermata it will no longer do to characterize as blood-vessels one set of structures in one group and another in another, but it will have to be shown how sometimes one and sometimes another part of the schizocœle-structures conveys the true blood-fluid and stands connected with the intestinal lacunæ.

We have therefore before us two different schizocœle-structures, two contrary systems, at first (Asterida) separated from one another, but which may afterwards partially communicate. The following table gives a summary representation of these schizocœle-structures :—

Asterida possess :—	*Five or more radial* (ambulacral) *longitudinal canals* (so-called perihæmal canals) *in the ventral wall of the arms and an oral annular canal.*	*Blood-lacunæ situated in the septa of the longitudinal canals and an oral blood-lacunar ring.*	*Blood-lacunæ at the vertical pole in septa of the dorsal schizocœle-cavities.*
Echinida.	Present (as neural canals).	Wanting; periœsophageal lacunar ring upon the lantern, with no connexion with the longitudinal canals. Intestinal lacunæ opening into it.	Present.
Spatangida.	Present; the oral annular canal has become connected with the intestinal lacunæ !	Wanting; blood-lacunar ring deficient.	Present.
Crinoidea.	Present; the oral annular canal connected with the intestinal lacunæ.	Wanting.	Present (situated partly in the arms).
Holothuriæ p.	Present; the oral annular canal connected with the intestinal lacunæ.	Wanting.	Wanting.

4. *Summary of Results, with a Description of the Principal Conditions of the Anatomical Structure of the Sea-urchins.*

In giving the following description of the anatomical and histological structure of a Sea-urchin, I indicate only the principal results which seem to me to be of importance for the comprehension of the Sea-urchin's body. At the same time I do not refer at all to the skeletal characters, seeing that these are already sufficiently known and investigated, especially through the works of Lovén and other naturalists.

In the Holothuriæ, which are destitute of any spines or similar structures, I have been able to describe the sense-organs situated in the skin. In the Sea-urchins these are nearly all (with the exception of the tentacles) placed upon stalked organs, the pedicellariæ. By this means an efficiency is secured to them which sense-organs on the skin could not develop on account of the frequently very long spines.

On the pedicellariæ, with their three-valved forceps, the mechanism of which I have described in detail, supposed sense-organs were observed by Sladen only in one form, the so-called gemmiform pedicellariæ; but neither that naturalist nor Köhler succeeded in demonstrating nerve-terminations.

Exquisite sense-organs occur in all pedicellariæ—gemmiform, tridactyle, and trifoliate. Special tactile eminences, often of complex structure, occur on the inner surface of the valves; these are beset with rigid setæ. Nerve-branches run to these tactile eminences. In general three nerve-cords, composed of the finest nerve-fibres and ganglion-cells, were observed; these pass into the capitular part, and while each gives off numerous lateral branches to the musculature, sense-epithelium, &c., they could be traced to the tip of each valve. The glandular sacs in the wall of the pedicellariæ are of particular importance in the seizing of any objects; whether they exert a paralyzing action upon smaller animals, such as worms, is still to be ascertained.

Following on these organs come the *globiferi*, newly discovered organs which serve as weapons. They occur only in a few genera. As further appendicular organs of the skin Lovén's remarkable *sphæridia* are to be mentioned. At their base may be found a nerve-ring of the same structure as that which is detected on the spines. From this basal nerve-ring, which shows itself externally by a thickened epithelium, an epithelial pad, nerve-fibres run sometimes to the musculature, sometimes running to the apex of the spine in the four, five, or more long ciliary bands. Similar nerve-structures occur

between the *sutural lines* or *semites* of the Spatangida; only in these the nerve-fibre layer, which is epithelial in position, is more strongly developed generally in the whole of the dorsal epithelium, but especially in that of these sutural lines.

Nerve-terminations are observed in the *ambulacral feet*, especially in the peculiar pencil-like foot of the Spatangida. The complex structure which occurs in the sucking-plate of the foot of a regular Sea-urchin can only be described by reference to the figures.

In the *epithelium*, the *epidermis*, which covers all the external organs, nerve-fibres occur everywhere. They are all epithelial in position, or only partially so; in the latter case they run subepithelially in the layer of connective substance, the cutis. The body-wall of a Sea-urchin is composed, as is well known, of the outer epithelium and the cutis with the calcareous plates or separate calcareous bodies, as, for example, in the buccal disk, or also at the vertical pole (in *Centrostephanus longispinus*). In the body-wall, and indeed in the middle of the paired, so-called ambulacral plates, run five *longitudinal canals*. They commence at the vertical pole beneath the five intergenital (ocellar) plates, and run to the lantern, the masticatory apparatus. They are schizocœle-structures, longitudinal canals, in the connective layer. Into them have been shifted the five ambulacral (or radial) nerve-trunks, which in the Starfishes are still situated in the ectoderm. These nerve-trunks terminate on the one hand in the intergenital plates, on the other they pass into the lantern and form a nerve-ring which, on one side, is enveloped by a continuation of the longitudinal canals. In and upon the intergenital plates there is a rudimentary tentacle without any visual spots. The nerve-trunks consist of very fine nerve-fibres and ganglion-cells and of a cellular coat which is in part composed of supporting cells. This epithelium is to be regarded as homologous with the epithelium of the ambulacral grooves of the Asterida, not only the nervous mass itself, but the whole epithelium, having come to be situated in the mesoderm, as in the Holothuriæ.

From the nerve- or central ring nerve-cords are given off to the œsophagus, and these may be traced throughout the whole course of the intestinal tract. Parallel to the ambulacral nerve-trunks run the five *ambulacral water-vessels*; they terminate cæcally in the intergenital plates, while at the masticatory apparatus they ascend upon its outer surface and enter into the water-vascular ring, which lies upon the surface of the masticatory apparatus (the lantern) and surrounds the œsophagus. From this water-vascular ring the

stone-canal takes its origin, ascends perpendicularly upwards, and opens outwards through the pores of madreporic plates. The latter possess no arrangement by which they can be closed; they are rather always open for the entrance and exit of the sea-water on the one hand, and of the fluid contents of the water-vascular system on the other.

The *sanguiferous cavities* consist of the following parts :— In the first place the five longitudinal canals and the annular space enveloping the nerve-ring. In the Echinida these structures have nothing to do with the true blood-lacunæ; the latter originate as ventral and dorsal intestinal lacunæ from the blood-lacunar ring which lies upon the surface of the lantern. From the dorsal intestinal lacuna branches ramify which run to the glandular organ (the so-called heart of previous writers) and surround it. At its terminal portion (it extends into the body-wall and, indeed, into the schizocœle-sinus of the anal pole) lacunæ of the anal blood-lacunar ring are in connexion with this organ. This lacunar ring runs in an annular schizocœle-sinus surrounding the anus, partly projecting into it, partly in its wall; from it blood-lacunæ are given off to the sexual organs.

Peculiar organs are the five vesiculiform lobate structures situated upon the surface of the lantern, and previously described as *Polian vesicles*. From the water-vascular ring a canal leads into them, opening into their cavity, while blood moves in the connective wall in lacunæ which stand in direct communication with the blood-lacunar ring.

In the Spatangida there are present the five longitudinal canals and the œsophageal sinus communicating with them. The true blood-lacunar ring has, however, disappeared with the lantern, and both the dorsal and ventral intestinal lacunæ open into this œsophageal sinus, in which the nerve-ring is situated, and which has been designated the blood-lacunar ring. The dorsal lacuna, however, runs beside an intestinal water-vessel, which latter originates from the annular canal, which likewise concentrically surrounds the buccal aperture. This water-vessel and the intestinal lacuna communicate with each other in their further course, and run along the gland until the true stone-canal, originating from the madreporic plate, enters into the web of vessels produced by the amalgamation.

In this way is produced a communication between the water-vascular system and the blood-lacunar system, and thus between cavities of entodermal and schizocœlar origin, such as occurs in no other group of Echinodermata. That this

condition is secondary may be asserted most decidedly, as the Spatangida are palæontologically the youngest forms.

A remarkable organ is the "ovoid gland," the structure formerly designated the heart. So far as one is justified in judging from the extant results, we may regard it as an organ in which materials no longer available for the body are deposited. Blood-lacunæ open at the ends into it or surround it, as in the Echinida. No efferent duct has yet been found in any group.

The origin of the sexual products is of especial interest; they consist of primordial germ-cells (*Urkeimzellen*), as I have proposed to name these cells. They lie in the dorsal wall in an annular genital tube, on which five sacciform diverticula are formed, into which the primordial germ-cells pass. These diverticula form the first foundations of the sexual tubes. From the primordial germ-cells the ovicells are produced by growth &c.; and by division &c. the sperm-cells, as well as the whole of the epithelium which afterwards lines the sexual organs.

In mature animals these sexual tubes are atrophied. How far a similar origin of the sexual products from such primordial germ-cells prevails in all Echinodermata I shall show immediately in another place (Zeitschr. für wiss. Zool. Bd. xlvi. Heft 1).

LI.—*On the Mammals collected by Captain C. E. Yate, C.S.I., of the Afghan Boundary Commission.* By J. Scully *.

Mr. Wood-Mason has asked me to contribute a paper on the collection of mammals and birds made by Captain C. E. Yate in Northern Afghanistan, and presented by that officer to the Indian Museum; the following notes are the result. The collection, I understand, was made after the departure of the naturalist of the Commission, so it may possibly include some forms not secured by him, and doubtless additional localities will now be made known for many of the species previously obtained.

* From a separate impression from the 'Journal of the Asiatic Society of Bengal, part ii. 1887, communicated by the Author. [The section relating to the Birds has not been reprinted, as it consists, almost exclusively, of a list of the species observed.]

The collection contains 13 species of mammals and 110 species of birds, those comprised in the first class being particularly interesting. I have carefully examined every specimen entered in the following list, and the identifications are as accurate as I can make them with the rather limited means of effecting comparisons. The localities and dates are carefully entered by Captain Yate on every ticket.

I have to express my thanks to Mr. Wood-Mason for giving me access to the collections under his charge at all sorts of unofficial hours, for permitting me to take most of Captain Yate's collection to my house for identification, and for procuring for me from many quarters sundry works for reference.

MAMMALIA.

1. *Erinaceus albulus*, Stoliczka.

This hedgehog agrees well with typical examples of the species to which I have referred it, from Yarkand. The fur on the whole lower surface of the body is white, the head and cheeks are pale rufescent fawn, the ears pale isabelline behind and white in front; the hands and feet are brown above, with a few white hairs intermixed. There is no nude area on the vertex; the spines measure 0·8 to 0·9 inch and have two dark and two pale bands, the tip being pale. Length of ear in front, from orifice, 1·45; fore foot 0·85, with claws 1·02; hind foot 1·4, with claws 1·53; tail 0·8. Teeth: $\frac{i.2}{}$ half the size of $\frac{i.3}{}$; $\frac{c.}{}$ has two fangs, anterior and posterior, $\frac{pm.1}{}$ two distinct fangs, $\frac{pm.2}{}$ three fangs, two buccal and one palatine. *E. albulus* seems quite distinct from *E. auritus*, with which I have compared it.

1. Maruchak, Murghab, Herat, May 23.
2. Badghis, Herat.

2. *Felis caudata* (Gray).

A flat skin, without skull. Nose to insertion of tail about 29·5 inches, tail about 13, hairs at tip of tail 0·7, ear from orifice at front 2·2, longest whisker 3·5, palma 3·2, planta 1·4. The ears are pointed, with a small tuft of hair at the apex measuring about 0·25. The general colour of the fur is above a pale yellowish grey, with dusky streaks, mainly along the centre of the back from nape to root of tail. Below, the fur is creamy white, with dusky spots showing through

here and there. The fur is soft and moderately long, grey at the base all over the body, then isabelline, and, where dark markings appear on the surface, the tips of the hairs are blackish. The head is grizzled grey, darker than the back, the sides of the nose pale fulvous, the cheeks white. The ears are pale isabelline behind, brown at the tips, and inside the hairs are whitish. The limbs are pale yellowish grey in front, with faint dusky markings near the body; inner side whitish, except the plantar and palmar surfaces, which are brownish black. Tail above on proximal half fulvous grey, with dusky dashes resembling those of the back, below whiter and almost free from dark markings like the belly; rest of tail greyish white, with four black rings and a black tip 1 inch long. This specimen is closer to *F. caudata* than to any other species with which I am acquainted; but from want of specimens for comparison and in the absence of the skull I cannot feel certain that the identification is correct.

1. Maimanah.

3. *Canis lupus*, Linn.

A flat skin, without skull. Nose to root of tail 37·5 inches; tail 12; hair at end of tail 2·5; ear from orifice in front 3·8. There is no black on the ears or the hind limbs; the fore limbs have a narrow black stripe down the front, ending about 6 inches above the point of the toes. Down the middle line of the back and along the upper surface of the tail the hairs are mainly black, and the tip of the tail is quite black.

1. Afghan Turkestan.

4. *Vulpes montana*, Pearson.

These are again two flat skins, without skulls. From nose to root of tail they measure about 29 and 31 inches; tail 15·5; hairs at end of tail 2·5. The face is rufous, with the usual dark patch below the eye; the ears are wholly black behind, the ordinary dark cross on the shoulders is present, and the tail-tip is white. One skin has the greater portion of the front of the fore limbs black; in the other this part is rufous; in both specimens the underparts are grey. In the larger animal, probably a male, the fur is much longer and softer and the tail more bushy than in the other; and the claws, which in both are unusually large, curved, and sharp-pointed, are more powerful. Both these skins can be fairly matched

in the large series of *V. montana* which I collected in Gilgit, and to that species I accordingly refer them.

1, 2. Afghan Turkestan.

5. *Spermophilus bactrianus*, sp. nov.

Ear-conch rudimentary, soles of hind feet densely haired, tail short, not longer than hind foot; hair on body harsh, very short, unicolorous.

Head and body (from skin) 9·5 inches; tail 1·5, with hairs at end included 2·2; fore foot without claws 1·25; hind foot without claws 2·25. On the head and whole body above and below the hair is very short, harsh, closely adpressed, and of the same colour throughout from base to tip. Upper parts nearly uniform pale fawn, the head slightly darker and more brown, and the rump more tinged with rufous; a pale isabelline band from nostril to eye. Tail like the rump, with a black subterminal ring and pale fulvous tip. Edges of lips, chin, throat, and whole lower surface, including inner aspect of limbs, creamy white. Outer aspect of limbs bright fulvous; upper surface of fore and hind feet pale isabelline, below to root of digits covered with creamy white hairs. The outer toe has a long pencil of whitish hair on its under surface which exceeds the tip of the claw by about half an inch. The vibrissæ are long, fine, and mostly brown, and a pencil of long glistening white hairs grows below the chin. The claws are black, with pale horny tips. There are three pairs of mammæ. The skull is imperfect behind, and its total length cannot be given; the posterior end of the nasals extends further back than the termination of the premaxillæ:—

	in.
Greatest breadth of zygoma	1·3
Breadth of brain-case behind postorbital processes	0·78
Length of nasals	0·8
Breadth of nasals behind	0·2
„ of nasals in front	0·26
Premolar to symphysis of premaxillæ	0·6
Posterior margin of palate to incisors	0·98
Breadth of palate between $\frac{pm.2}{}$	0·27
Length of mandible, condyle to symphysis	1·3

From the characters already given for this souslik it could not be referred to any species of *Spermophilus* belonging to the section in which the hind feet are not haired below, e. g. *S. fulvus*, *S. rufescens*, *S. erythrogenys*, *S. brevicauda*, *S. mugosaricus*, *S. concolor*, or *S. musicus*. Of the section having well-haired soles *S. Eversmanni* and allies are also

excluded by the length of the tail; Middendorff gives the length of tail in *S. Eversmanni* as 4·2 inches, with terminal hairs 5·5. Of the short-tailed subsection *S. citellus*, *S. dauricus*, *S. guttatus*, *S. xanthoprymnus*, and *S. mongolicus* are excluded for various but good and sufficient reasons, which to enumerate would be long. The only likely species that remains is *S. leptodactylus* of Lichtenstein, and to it I was at first disposed to refer the specimen collected by Captain Yate. The position of Lichtenstein's species is, in the first place, involved in doubt; it was distinctly described as having the hind feet haired below; but, according to Brandt (Bull. Acad. Sc. St. Petersburg, ii. p. 359), Eversmann proved to his satisfaction that *S. leptodactylus* was the same species as *S. fulvus*, which has the soles bare. However this may be, I have carefully compared Lichtenstein's detailed description of his *Citillus leptodactylus* ('Säugethiere,' tab. xxxii.) with the specimen under notice, and can only come to the conclusion that the latter is perfectly distinct, even if the question of hair on the soles be left out of consideration. In describing this species as new I have not overlooked Brandt's caution about the young of bare-soled sousliks having sometimes that part tolerably well covered with hairs.

1. ♀, Khamiab, Afghan Turkestan, June 12.

6. *Gerbillus*, sp.

Head and body about 5·4; ear at front from orifice 0·6; fore foot 0·38, with claws 0·45; hind foot 1·2, with claws 1·3. Fur long, fine, and very soft. Bright rufous-brown or fawn-colour above, many of the hairs black-tipped, the basal parts of the hair leaden grey; below the hairs white throughout their length. Ears fairly well haired, fawn-coloured behind, with a white margin, in front with scanty white hairs at the margins; whiskers white. Fore limbs white above and below, the palms naked; hind feet isabelline above, with whitish hairs on the soles, including the toes, except part of the hinder portion of the tarsus. The tail is imperfect; but its basal part for about 2·5 inches is coloured like the back above, and is slightly paler below.

The upper incisors are well grooved, the enamel folds of the upper molars are completely united in the middle, exactly as in *G. hurrianæ*, and the hinder molar has not a vestige of any posterior talon—the outline of the crown as seen from above being simply a narrow oval, with the points of the oval buccal and palatine. The following are the principal measurements of the skull:—

	in.
Total length	1·58
Breadth of zygomatic arch	0·85
„ of brain-case at posterior root of zygoma	0·69
Length of palate to incisors	0·69
„ of nasals	0·6
Mandible, condyle to symphysis	0·78

Although the upper molars agree best with those of *G. hurrianæ*, this specimen is quite different in character and colour of fur and in shape of skull; neither can it be referred to *G. erythrurus*, with which I have compared it. It possibly represents a new species; but, as the tail is imperfect, I do not propose a name for it.

1. ♂, Balkh, Afghan Turkestan, July 4.

7. *Mus bactrianus*, Blyth.

This specimen agrees fairly well with typical examples of *M. bactrianus*; but the tail is shorter than the head and body, though this is not of importance in a skin. In comparing this specimen, I have had occasion to examine many specimens of *M. pachycercus*, Blanford, from Yarkand; and I may note that that species is quite distinct from *M. bactrianus* and has been happily named.

1. ♂, Chahar Shamba, Maimanah, April 4.

8. *Arvicola Guentheri*, Danford and Alston.

Head and body 4·4 inches; hind foot 0·77; ear at front 0·4. The external form and colours agree well with the original description of the species from Asia Minor (P. Z. S. 1880, p. 62), except that in this specimen the rudimentary thumb of the fore foot has a small nail. The pattern of the molar teeth is very similar to that of *A. Guentheri*, with the following exceptions:—

In this specimen $\underline{m.1}$ has not the rudimentary fourth angle on the inner side so prominent; it is barely indicated. On $\underline{m.2}$, however, this posterior inner angle is distinct and must be counted, although in the original description above cited it is omitted. $\underline{m.3}$ has the posterior lobe less prolonged backwards, and tends less to form an angle on the outside than in the Asia-Minor species. $\overline{m.1}$, too, has the anterior lobe more compressed laterally in the present specimen. The following table exhibits the molar pattern according to the usual mode of counting:—

	Spaces.	External angles.	Internal angles.
$\frac{m.\ 1}{\quad}$	5	3	3
$\frac{m.\ 2}{\quad}$	4	3	3
$\frac{m.\ 3}{\quad}$	6	3	4
$\frac{\quad}{m.\ 1}$	9	5	5
$\frac{\quad}{m.\ 2}$	5	3	3
$\frac{\quad}{m.\ 3}$	3	2	3

1. Afghan Turkestan.

9. *Ellobius intermedius*, sp. nov.

Head and body (from skins) 4·5 to 5 inches; tail 0·4 to 0·45; hind foot 0·8 to 0·9; fore foot 0·55 to 0·67. Colour above, and on sides of head below the zygomatic projection, bright pale yellowish red (or bright rust-colour). Head dark brown. Below greyish white throughout. Tail pale fulvous, the terminal hairs at tip white. Fore and hind feet whitish. Fur short (about 0·35 on hinder part of back), very soft and fine; dark grey or leaden at the base, except on centre of belly, where it is white throughout its length. The bright colour of the upper surface being due to the short pale-coloured tips of the hair, any abrasion of these gives the animal a dark leaden-grey colour above.

Skull:—

	in.	millim.
Breadth across hinder part of zygomatic arches	1·05	27
„ of interorbital constriction	0·21	5·5
„ of brain-pan behind posterior termination of zygoma	0·62	16
Length from anterior molar to incisors	0·54	14
„ of upper molar series.....	0·32	8
„ of palate to incisors	0·86	22·5
Breadth of palate between anterior molars	0·14	4
Length of lower jaw, condyle to symphysis.....	1·05	27
„ of lower molar series.....	0·33	8·5

The nasals are shaped somewhat like a wine-bottle bent in at the sides, their external margins being nearly straight behind, then convex, then strongly concave, and, finally, convex again at the front end; the posterior ends are pointed, not truncated. The posterior ends of the premaxillæ extend quite 3·5 millim. behind the ends of the nasals and the same distance beyond the origin of the zygomatic arch. The zygomatic arch is high throughout; the maxillary process does not reach the squamosal along the lower margin, a square process from the malar interposing itself and forming the lower edge of the arch for a length of 1·5 millim.

The skull differs from that of *E. fuscocapillus* in having the nasal portion shorter, the distance from anterior root of zygoma to symphysis of premaxillaries being 15 millim. in *E. fuscocapillus*, against 12 millim. in the present species. The zygomatic arch is quite differently shaped, being higher throughout, and the malar bone forms part of the lower margin, while in *E. fuscocapillus* the maxillary and squamosal processes meet along the lower margin, so as to exclude the malar; and the anterior palatine foramina are much smaller and narrower.

From *E. talpinus* the skull of the present species differs completely in the shape of the nasals and in the extension backwards of the end of the premaxillæ. The shape of the zygoma presents even a greater divergence than from *E. fuscocapillus*; but the arrangement of the bones in the arch is closely similar in *E. talpinus* and *E. intermedius*. The anterior palatine foramina are very much smaller than in *E. talpinus*; and there are other differences which will be apparent on studying Mr. Blanford's very clear account of the contrast between the skulls of *E. fuscocapillus* and *E. talpinus* in J. A. S. B. vol. l. pt. 2, 1881, pp. 122, 123.

Teeth. The incisors are very long and pure china-white. The molar pattern is as follows:—

	External angles.	Internal angles.
$\underline{m.1}$	3	3
$\underline{m.2}$	3	2
$\underline{m.3}$	3	2
$\overline{m.1}$	4	5
$\overline{m.2}$	3	3
$\overline{m.3}$	3	3

$\underline{m.1}$ and $\underline{m.2}$ do not differ from the corresponding teeth in *E. fuscocapillus* and *E. talpinus* in any important particular. $\underline{m.3}$ differs markedly from the corresponding tooth in *E. fuscocapillus*, and resembles that of *E. talpinus* in wanting a posterior lobe behind the hindmost outer angle; both the internal angles too are less prominent in the present species, the last angle being much rounded.

In $\overline{m.1}$ the anterior lobe is less developed than in *E. fuscocapillus*, but still there are four external and five internal angles, not three and four as in *E. talpinus*.

The three species of *Ellobius* may be thus contrasted:—

E. talpinus.	*E. intermedius.*	*E. fuscocapillus.*
1. Base of fur almost black.	1. Base of fur dark or leaden grey.	1. Base of fur light grey.
2. Zygoma low, malar interposed between maxillary and squamosal processes in lower margin.	2. Zygoma high throughout, malar interposed between maxillary and squamosal processes in lower margin.	2. Zygoma high in middle, maxillary and squamosal processes alone form lower margin.
3. Nasals convex externally.	3. Nasals bottle-shaped, or external margin alternately convex and concave.	3. Nasals bottle-shaped, or external margin alternately convex and concave.
4. Premaxillæ terminate posteriorly opposite end of nasals.	4. Premaxillæ prolonged behind hind end of nasals.	4. Premaxillæ prolonged behind hind end of nasals.
5. $\overline{m.3}$ has no posterior lobe behind last outer angle.	5. $\overline{m.3}$ has no posterior lobe behind last outer angle.	5. $\overline{m.3}$ has a prominent posterior lobe behind last outer angle.
6. $\overline{m.1}$ angles 3–4.	6. $\overline{m.1}$ angles 4–5.	6. $\overline{m.1}$ angles 4–5.

For the comparison of the three specimens collected by Capt. Yate, I have Mr. Blanford's very full description of a skin and skull of *E. fuscocapillus* (with figure of skull and teeth) in the paper before cited, and three skins and a skull of the same species in the Indian Museum. I have no specimen of *E. talpinus* for comparison, but Mr. Blanford has so clearly and, I am sure, accurately given the differences between that form and *E. fuscocapillus*, that I have no hesitation in deciding that Capt. Yate's specimen must be referred to a new species. The only known locality for *E. fuscocapillus* is Quetta, and the Russian *E. talpinus* is recorded by Severtzoff from Western Turkestan; so that the present species is intermediate in its habitat, as well as in its distinctive characters, between the two better known species of the genus. Severtzoff calls his Turkestan specimens *E. talpinus*, var. *rufescens*, and these may prove to belong to the species I have described.

Capt. Yate notes on the ticket of one of the specimens, "Eyes scarcely visible; caught by day."

1. Bokun, Murghab, Herat, May 10.
2. Kila Wali, „ „ May 14.
3. „ „ „ May 26.

10. *Lagomys rufescens*, Gray.

The two examples collected belonging to a well-marked and well-known species need no extended notice; they agree perfectly with specimens collected by Blanford in Persia. The species was originally described from a specimen obtained in Afghanistan.

1. Shadian, Afghan Turkestan, August 2.
2. „ „ „ August 6.

11. *Lepus Lehmanni*, Severtzoff.

This specimen is not in very good order, and I refer it rather doubtfully to the species described by Severtzoff (see Ann. & Mag. Nat. Hist. 1876, vol. xviii., "The Mammals of Turkestan"), with which, on the whole, it seems to agree best. So many species of Asiatic hares have been described which differ only in minute particulars as to make the task of identifying a particular specimen difficult and uncertain; for the number of nominal species probably greatly exceeds the constantly distinguishable forms. In the specimen obtained in the Hindu Kush the ears measure, from orifice in front, about 4·3 inches, at back 4·8, greatest breadth about 2·7. The anterior external part of the ear is coloured like the back; the posterior part being pale isabelline, black at the tip and partly down the posterior margin.

The general colour above is mixed pale fawn and black. The chin and belly are white, and the throat and breast pinkish isabelline. The basal part of the fur above, and where coloured on the limbs and breast, is grey; on the belly the fur is white throughout its length.

The premaxillaries end behind on a level with the nasals, the latter bones having the posterior end sloping inwards and the junction of their outer and hinder margins slightly rounded.

The mandible from condyle to symphysis measures 3·4 inches.

1. Hindu Kush, Afghan Turkestan.

12. *Gazella subgutturosa*, Güldenst.

Head and horns, with skin of head, preserved. Band from between horns to nostrils rufescent fawn. A pale isabelline band outside this from level of inner canthus of eye to upper lip. A dark rufous-fawn stripe from eye-pits to commissure of lips. The ear measures about 5·25 inches in length from orifice to tip in front. The horns from the base curve outwards, forwards, then backwards, and at the tips they curve inwards and forwards. There are twenty rings on each horn, and these end about 2·5 inches from the tips. The horns measure 14·7 inches in length along the curve in front, the distance of the tips apart is 6·9, the greatest distance apart 7·5, and the girth at the base about 4·5.

1. ♂, Badghis, Herat.

13. *Cervus cashmirianus*, Falconer.

This is a cast left antler of an elaphine stag, about which Capt. Yate gives the following information :—"This was a horn from the banks of the Oxus, near Balkh, and will help to determine the identity of the deer found in the jungles along that river." The antler is not perfect, as the beam is broken above the royal, so that the form of the crown cannot be ascertained; the following are the measurements :—

	in.
Length from burr to broken end of beam along curve inside	17·8
„ of brow tine, about	4·0
„ of bez tine, about	7·0
„ of royal tine along curve, about	7·7
„ of beam above upper angle of royal	6·9

Viewed in front, the beam is nearly straight (though of course inclined outwards) as far as the royal, where it begins to curve inwards. Viewed from the outer side, it curves slightly back from the bez and forwards to the origin of the royal; above the royal it curves gently back, and then forwards and inwards. The brow tine is straight and directed somewhat upwards: the much longer bez is directed outwards and upwards, and towards its tip it has a slight curve inwards; the royal is directed first outwards, then it curves at about 3 inches from the beam strongly upwards and inwards, the point being well inside the line of the broken end of the beam. Without measurement the bez looks longer than the royal, and the middles of the bez and brow tines, measured along the middle line of the beam, are 2·5 inches apart, or from upper margin of brow to lower margin of bez at junction with beam about 1·7 inches.

It is quite clear, I think, that this antler agrees better with that of *C. cashmirianus* than with that of any other deer to which it could be referred. It is quite distinct from *C. maral*, as figured by Sclater in Trans. Zool. Soc. vol. vii. I may mention that Mr. Wood-Mason, who examined this horn before I saw it, came to the conclusion that it must be referred to *C. cashmirianus*. Of course the evidence of such a fragment is not conclusive proof that the stag of the Oxus basin is really identical with the Kashmir species; complete specimens are necessary for the settlement of that point.

1. Banks of Oxus, near Balkh, Afghan Turkestan.

MISCELLANEOUS.

On the Affinities of the so-called Torpedo (Cyclobatis, *Egerton*) *from the Cretaceous of Mount Lebanon.* By A. Smith Woodward, F.G.S., F.Z.S.

In 1844, Sir Philip Egerton read a paper before the Geological Society of London, describing a small Selachian from the chalk of Mount Lebanon, under the name of *Cyclobatis oligodactylus*; six years later Prof. F. J. Pictet figured a second specimen, showing further anatomical details; and quite recently Mr. James W. Davis has published some notes on the genus, adding a new species, *C. major*. Following Egerton's original determination, the fish seems to have been universally regarded up to the present time as referable to the Torpedinidæ, partly on account of its rounded shape, and partly on account of the supposed absence of dermal defences. The fine series of specimens now in the British Museum, however, appears to demonstrate conclusively that these generally accepted views as to affinities of *Cyclobatis* have no sure foundation in fact. That the genus is truly referable to the Trygonidæ seems evident from the following considerations:—(1) The pectoral fins are uninterruptedly continued to the end of the snout, and were thus probably confluent in front. (2) The pelvic arch is placed far forwards, and the rays of the pelvic fins scarcely extend posteriorly beyond the extremity of the pectorals. (3) There are no traces of median fins. (4) The skin is armed with spinous tubercles. The fact last named has not been noted before; but on the dorsal aspect of the fish there is a longitudinal median row of large spinous tubercles, and the remainder of the body and fins is covered with innumerable prickles. In one small fossil the tail has the appearance of being completely encased in rows of the large tubercles. There is thus no evidence, as yet, of the existence of 'electric rays' of an earlier date than those made known by Volta and Baron de Zigno from the Eocene of Monte Bolca, near Verona, in Northern Italy.—*Abstract, Section C, British Association, Manchester*, 1887.

Zygæna dissimilis, Murray.

Gentlemen,—In the 'Annals and Magazine of Natural History' for October is a paper by Mr. Murray, of the Kurrachee Museum, who in describing a hammer-headed shark which he supposed to be new, observed upon it not being delineated in my 'Fishes of India.' The reason seems to be that the species is the *Zygæna mokarran* of Rüppell, figured in Taf. 17. fig. 3, 'Neue Wirbelthiere der Fauna Abyssinien,' 1835, and who fully described the fish. I did not obtain it in India when there, neither did it exist in any of the local museums, which was my reason for not inserting it. Also *Lamna Guentheri* of the same author from the same locality, described in your journal, (5) vol. xiii. p. 349 (1884), is figured and described in my work as *Carcharias tricuspidatus*, p. 713, pl. 186. fig. 1.

Cheltenham, Oct. 24, 1887. Francis Day.

On the Sexual Generation of Chermes abietis, *Linn.*

By Dr. F. Blochmann.

I was led by the preparation of my lecture "Ueber ausgewählte Kapitel aus der Fortpflanzungs- und Entwicklungsgeschichte der Thiere" to attend in more detail to the cyclical development of the Aphides, and in this way I became aware of many still existing gaps in our knowledge. One such hiatus is to be found in the history of the reproduction of the genus *Chermes*, seeing that, notwithstanding the efforts of various distinguished observers, it was still undecided whether a sexual generation does or does not occur in its cycle of development. As the galls of *Chermes* are very abundant at many places here in Heidelberg, and especially on the so-called "Himmelsleiter," I took occasion during my walks to observe their development, in order to detect the sexual animals, the existence of which I fully expected to find from the great similarity of the course of development in *Chermes* and *Phylloxera*. In this I soon succeeded, and I would not omit giving a short communication here, especially because at the moment I am not in a position to furnish a detailed description with figures.

For the most detailed observations upon the life-history of the Bark-lice we are indebted chiefly to Ratzeburg* and Leuckart†. What is known from them is as follows:—In the autumn we find at the bases of buds of the fir small wingless animals covered with grey wool, which have buried their long proboscis deeply in the tissues, and in this position live through the winter. In the spring they grow considerably, with several changes of skin, the sexual organs especially becoming developed. The investigation of the latter shows that the animals are all *unfertilized* females. They now begin to lay a great number (up to about 200) of pedunculated eggs, which remain lying under the mother, enveloped in dense white wool. These soon become developed into female larvæ, which crawl between the leaves of the expanding bud. These are already deformed at the base of the bud by the sucking of the mother, and become still more so now by the united efforts of the brood, so that the well-known pineapple-like galls are produced. I may state here that of the two species, which are usually distinguished by the formation of their galls, the one which makes the smaller galls (*Chermes coccineus*, Ratz. = *C. strobilobius*, Kalt.) has served for my investigations.

In the galls the young animals increase in size, with several changes of skin, and develop wing-sheaths. At the beginning or middle of June the different chambers of the gall open, the nymphs crawl out upon the leaves of the nearest twigs, and then change their skin for the last time. After this moult they appear as winged insects, which, in fine weather quit the twig and settle themselves

* Die Forstinsekten, Bd. iii. pp. 195–205 (1844).

† "Die Fortpflanzung der Rindenläuse," in Arch. für Naturg. 1859, pp. 208–231.

here and there, usually not far from the gall out of which they crept forth. Anatomical examination shows that these animals also are all females, but that they differ in the structure of the ovary, by a much smaller number of egg-tubes, from the hybernating generation, which remained wingless. Ratzeburg believed that he observed a few males among these winged animals; but this was certainly due to an error, as, indeed, Leuckart has remarked. (Nevertheless O. Taschenberg still reproduces Ratzeburg's figure with the erroneous description—see 'Die Verwandlungen der Thiere' (1882), p. 224.)

These winged females settle themselves almost exclusively on the underside of older leaves, cover themselves again with a light woolly secretion, and lay a small number (I usually observed 8–12) of eggs, which, in dying, they cover with their roof-like wings. From these, consequently also unfertilized eggs, small yellowish creatures are developed, which, according to the opinions hitherto prevalent, should become developed into the wingless female generation, hybernating at the base of the buds. This course of development was regarded as certain by Leuckart in his memoir above cited; while subsequently *, from the analogy of the conditions of reproduction in the true Aphides, he regarded the existence of a sexual generation as possible, especially as Claus had informed him that he had once examined male fir-lice.

The supposition that the progeny of the winged females was the hybernating generation producing the galls in spring (which, however, no one had directly traced) was erroneous, for, in point of fact, their descendants are the *sexual animals* †. The newly-hatched animals remain for some time under the body of their mother, where they moult once; then they disperse themselves and creep briskly about on the bark of the twigs. Examination with the lens shows a difference among them. As already stated, they are in general of a yellowish colour. Some, however, strike one by the brownish extremity of the abdomen and also by their greater activity. These are the *males*. Anatomical examination shows in them two testes of considerable size, with mature and rather large spermatozoa, and a rather long penis beset with short hooklets. In the more sluggish females the end of the abdomen is not of darker colour. The sexual organs, as in the sexual generation of *Phylloxera*, consist of *a single egg-tube*, which, in the specimens examined, contains *a single* large ovum, which being not yet furnished with a chorion and vitelline membrane, is consequently not quite mature. On the oviduct are seated two lubricating glands and a large *receptaculum seminis*, which I have always found tightly packed with spermatozoa. It is further remarkable that both sexes possess

* "Die Fortpflanzung der Blatt- und Rindenläuse," in Blomeyer, A., Mitth. der landw. Inst. d. Univ. Leipzig, Heft i. (1875) p. 136.

† Whether the eggs deposited by the winged animals are to be recognized, as in *Phylloxera*, by their size as male and female I cannot say, as I have omitted attending specially to this point.

a well-developed proboscis and intestine, and therefore are certainly fitted for the reception of food.

While the males run briskly about in all directions upon the twigs, the females wander slowly but uninterruptedly downwards, that is towards the trunk. Of course, during this progress they are met with by the rambling males, and I had frequent opportunities of observing them *in copulâ*. The fertilized females then crawl away, and thus it happens that one usually finds many more males than females. The latter creep upon the somewhat thicker branches into the fissures of the bark, and especially under the appendages at the base of the leaves, the so-called "Stollen," and here deposit their eggs. The females are easily found here, living or dead, along with the eggs. The latter are about 0·5 millim. in length and 0·22 millim. in thickness, enveloped in a little whitish wool. Usually two or three eggs lie together, and I regard it as not impossible that they are deposited by *one* female, as the latter might no doubt take nourishment, and so, after depositing the first egg, bring a second or even a third to maturity. I could detect the dead females and their eggs not only upon the twigs but also under scales of bark on the trunk itself. However, the firs on which I made these observations are still young trees, about 5–6 metres in height.

I observed the flying parthenogenetic females on the 19th of June. As many galls were then emptied, males and females were already present. I found the fertilized eggs deposited under the bark on the 2nd of July, and in all that came under observation the blastoderm was already developed. In this condition they remained until now (July 23 *) according to observations made concurrently upon twigs in the open and preserved in glasses in the house. We may assume with certainty that from these eggs proceeds the wingless hybernating generation which we find in October at the bottom of the buds.

Hence we now perfectly know the developmental cycle of *Chermes*. It may be summarized as follows:—

1. A hybernating, wingless, parthenogenetic generation;
2. A winged parthenogenetic generation;
3. A generation of male and female wingless animals, from the fecundated eggs of which the first generation is again produced.

The whole course of development thus closely approaches that of *Phylloxera*, the only difference being that in *Chermes* the wingless females proceeding from the fecundated eggs directly produce the winged generation, while in *Phylloxera* a greater number of wingless generations intervenes between them.—*Biologisches Centralblatt*, September 15, 1887, Band vii. pp. 417–420.

* The eggs remained in the same stage of development until August 14 (when the proof was corrected).

10

CONTENTS OF NUMBER 119.—*Fifth Series.*

Page

XLII. The True Nature of the "Madreporic System" of Echinodermata, with Remarks on Nephridia. By Prof. Marcus M. Hartog, D.Sc., M.A., F.R.U.I. 321

XLIII. The New System of *Chalininæ*, with some Brief Observations upon Zoological Nomenclature. By Arthur Dendy, B.Sc., F.L.S., Assistant in the Zoological Department of the British Museum 326

XLIV. A List of the Japanese *Silphidæ*, with Descriptions of new Species. By George Lewis, F.L.S. 338

XLV. On the so-called *Microdon nuchalis*, Dixon, from the Chalk of Sussex, a new Species of *Plataxa*. By A. Smith Woodward, F.G.S., F.Z.S., of the British Museum (Natural History) 342

XLVI. List of Reptiles and Batrachians from Cyprus. By G. A. Boulenger 344

XLVII. On the Affinity of the North-American Lizard-Fauna. By G. A. Boulenger 345

XLVIII. Notes on *Volutharpa Perryi*. By Edgar A. Smith 347

XLIX. Descriptions of some new Genera and Species of *Curculionidæ*, mostly Asiatic.—Part IV. By Francis P. Pascoe, F.L.S. &c. 348

L. On the Phylogeny and Anatomy of the Echinodermata. By Dr. Otto Hamann 361

LI. On the Mammals collected by Captain C. E. Yate, C.S.I., of the Afghan Boundary Commission. By J. Scully 378

MISCELLANEOUS.

On the Affinities of the so-called Torpedo (*Cyclobatis*, Egerton) from the Cretaceous of Mount Lebanon. By A. Smith Woodward, F.G.S., F.Z.S. 389

Zygæna dissimilis, Murray. By Francis Day, F.Z.S. &c. ..... *ib.*

On the Sexual Generation of *Chermes abietis*, Linn. By Dr. F. Blochmann 390

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[FIFTH SERIES.]

No. 120. DECEMBER 1887.

LII.—*On* "Orthoceras [Endoceras] duplex," *Wahlenberg et auctt., with Descriptions of three new Species of* Endoceras *from the Ordovician of Sweden and Russia contained in the British Museum* (*Natural History*). By ARTHUR H. FOORD, F.G.S.

THERE are a great many specimens of *Endoceras* in the British Museum from Sweden, Northern Germany, and Russia, bearing upon their labels the well-known name of "*Orthoceras duplex*," Wahlenberg. But on referring to the original description of that species *, which is unaccompanied by any figures, one finds that it is insufficient for purposes of strict identification, and, in point of fact, many diverse forms of *Endoceras* have consequently been united under Wahlenberg's appellation. The essential part of his description is contained in the following passage, translated from the Latin original:—

"*Orthoceratites duplex* or *giganteus* is found in Westrogothia, and there only complete and well developed, particularly in Mount Kinnekulle. The diameter is mostly a hand's breadth, and sometimes as much as five Parisian inches, a size of the tube surpassing that of any other univalved many-

* Nova Acta Reg. Soc. Scient. Upsaliensis, 1821, vol. viii. p. 86.

chambered testaceous animal which I have seen alive or dead. Its form is rather cylindrical than conical, and in addition to its great breadth it has a length of six feet and more, so that we are convinced that it surpasses in magnitude all Ammonites hitherto discovered, and that it is thus the largest of all univalved testaceous animals. Its siphuncle is mostly situated quite on the margin or on the circumference of the shell, and not quite hidden by the joints of the external shell; occupying about a third part of the entire shell. On account of its situation on the margin, the segmental partitions [septa] of the shell form very oblique rings on the surface of the siphuncle, and at the same time run outwards over its face, whence it results that the siphuncle seems as it were to consist of hoods or wrappers, set or inserted upon one another, as if it sent out processes. The outer wall of the siphuncle is entire and free from perforations, showing no point of communication between the cavity of the siphuncle and the chambers of the exterior shell."

The author then proceeds to describe the smaller *Orthoceras* lodged in the siphuncle of "*Orthoceras duplex*," from which circumstance the specific name originated. It need hardly be said that the included *Orthoceras* was introduced by accident into the capacious siphuncle of the larger one*. Judging by Wahlenberg's description, which is almost confirmed by his reference to one of Klein's figures ('Descriptiones Tubulorum Marinorum,' 1731, tab. vi. figs. 1, 2), his species was most probably *Endoceras trochleare*.

It appears that Wahlenberg's views regarding the imprisoned specimen were not shared in by some of his scientific brethren, for he observes with much *naïveté* that "many people interested in natural phenomena have regarded this internal *Orthoceratites* as a different species, on account of its annular form; and the inhabitants of Mount Kinnekulle well distinguish it from the common *Orthoceratites* under the name "Svecico skrufstenar" [Swedish screw-stone], a by no means inapt sobriquet for *Endoceras trochleare*.

Selecting from Wahlenberg's description of "*Orthoceras duplex*" those parts of it which are essential to a specific diagnosis, they are found to consist of two only, viz. the form of the shell, which is said to be "rather cylindrical than

* This is of course no uncommon thing. Barrande gives numerous figures of *Endoceras* and *Orthoceras* into whose siphuncles young or smaller shells belonging to those genera have been introduced after the death of the animal and the partial destruction of its shell. (See Syst. Sil. de la Bohême, vol. ii. pl. ccccxxxviii. figs. 9, 11; also Pal. of New York, by James Hall, vol. i. 1847, pl. xlviii. fig. 3.)

conical," and the proportionate size of the siphuncle, "occupying about a third part of the entire shell." These two characters would obviously not be sufficient for specific distinction, and the vagueness of the original description has given rise to a number of widely differing forms being placed under one specific name, according to the interpretation, generally a very liberal one, that each author has put upon the description. To make confusion worse confounded another of Wahlenberg's species—"*Orthoceras commune*"—has become entangled in the nomenclature of "*O. duplex*." According to the original description of the former (Nov. Act. *loc. cit.* p. 85) *O. commune* is not an *Endoceras*, but an *Orthoceras*, for the siphuncle is described as of moderate thickness, "equal to nearly a tenth part of the diameter of the whole shell, taken transversely," and "is for the most part situated midway between the axis and the circumference of the shell." Hisinger *, who was the first to give figures of fossils under Wahlenberg's names "*duplex*" and "*commune*," adds very little to our knowledge of those forms, and to his brief description of the former he appends the words "an species distincta?" a somewhat significant phrase, which seems to suggest the difficulty he experienced in identifying Wahlenberg's species.

Having thus failed in obtaining the required information from the books, I explained my difficulties to Dr. Lindström, and he, with no less kindness than promptitude, caused inquiries to be made for me as to whether Wahlenberg's types of "*O. duplex*" and "*O. commune*" still existed in the museum at Upsala, where some of his types are preserved. But they could not be found, so that there is now no possibility of identifying Wahlenberg's species. Dr. Lindström informed me, moreover, that he had "searched in vain" in the "Hisinger Collection" of the Royal Museum, Stockholm, for the original specimens of "*O. duplex*" and "*O. commune*" figured by Hisinger in the 'Lethæa Svecica.'

Under these circumstances it is desirable, as Dr. Lindström has suggested to me, that Wahlenberg's names should be relinquished, and new ones imposed upon all Swedish and Russian Endocerata which have hitherto fallen under them. This task has been already partly accomplished by such able palæontologists as Dewitz and Schröder in Germany and Holm in Sweden, and, so far as I am aware, there remain now very few forms requiring emendation. The collection of Swedish specimens of *Endoceras* in the British Museum has

* 'Lethæa Svecica,' 1837, p. 28.

been greatly enriched within the last few years through the munificence of the late Mr. J. E. Lee, of Torquay, and it is principally upon this new material that the following descriptions are based. I have named the first species after the illustrious Swedish naturalist Wahlenberg.

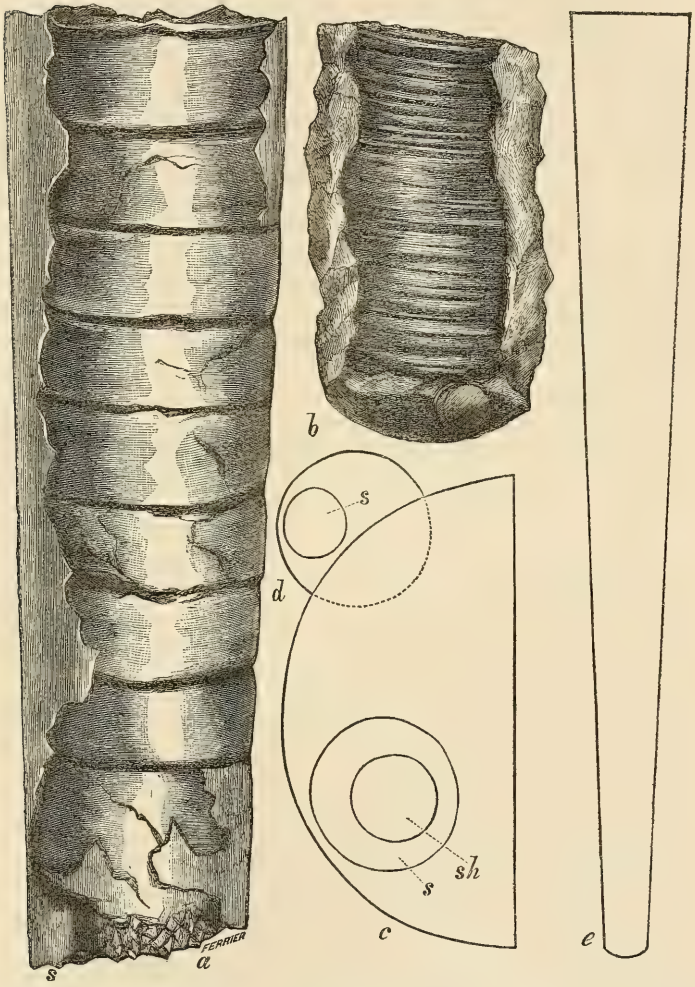
Endoceras Wahlenbergi, sp. nov.

1732. Species vi. *Orthoceratites siphone ad peripheriam posito crassiori*, &c., Breynius, Dissertatio physica de Polythalamiis, p. 34, tab. iv. figs. 4–6.
1759. *Orthocerati recti. . . . in Dahlia reperti.* De rariori quadam Orthoceratitis Specie, in Suecica reperta, tractatus, &c., Nicholas de Himsel, Phil. Trans. vol. l. pt. 2, p. 692, tab. xxiii. fig. A.
? 1775. *Orthoceratites*, Walch and Knorr, Monumens des Catastrophes de la Terre, tom. iii. suppl. p. 140, tab. iv *e*. fig. 1.
1837. *Orthoceratites duplex*, Hisinger, Lethæa Svecica, p. 28, tab. ix. fig. 1.
? 1855. *Orthoceras duplex*, Barrande, in Leonhard and Bronn's Neues Jahrb. p. 264, Taf. iii. figs. 11, 11*.
1857. *Orthoceras commune*, Boll, Archiv für die Naturkunde von Meklenburg, p. 12, Taf. ii. figs. 4, *a*, *b* (not of Hisinger).
? 1861. *Orthoceras duplex*, Rœmer, Fossile Fauna von Sadewitz, p. 60, pl. vii. figs. 2, *a*, *b*.
1866. *Endoceras* (*Orthoc.*) *duplex*, Barrande, Syst. Sil. de la Bohême, vol. ii. Texte iii. 1874, pp. 709, 713, pl. ccxxxiii. fig. 9, pl. ccccxxviii. figs. 9–12.
? 1869. *Orthoceras duplex* (*giganteum*), Karsten, Die Verstein. des Uebergangsgebirges in den Geröllen der Herzogthümer Schleswig und Holstein, p. 49, tab. xvii. fig. 6, *a*, *b*.
? 1875. *Orthoceras duplex*, Mallada, Bol. Com. Mapa Geol. España, tomo ii. p. 24.
1876. *Orthoceras duplex*, Rœmer, Lethæa Geognostica, Theil i. Leth. Palæoz. Atlas, Taf. vi. fig. 2, *a*, *b*.
1880. *Orthoceras duplex*, Angelin-Lindström, Fragm. Silurica, p. 1, tab. iii. figs. 9–11.
1881. *Endoceras duplex*, Schröder, Schriften der physikalisch-ökonomischen Gesellsch. zu Königsberg, Jahrg. xxii. Abth. i. p. 82, Taf. iii. figs. 1, A, B.
1882. *Endoceras cf. duplex*, Barrois, Terr. anciens des Asturies et de la Galice, p. 187, pl. iv. figs. 7, *a*, *b*, *c*.
1885. *Orthoceras* (*Endoceras*) *duplex*, Rœmer, Lethæa erratica, in Dames and Kayser's Paläontologische Abhandl. Band ii. Heft 5, p. 38, Taf. ii. figs. 2, *a*, *b*.

Sp. char. Shell straight, very long. Tapering rather slowly at the rate of about 1 in 12, taking the average measurement of three adult specimens. Section circular. Body-chamber unknown. Septa moderately distant, that is, about 8 lines apart at a diameter of $2\frac{1}{4}$ inches, decreasing to a distance of 3 lines at a diameter of 8 lines. The distance of the septa varies considerably in different specimens, and even in different parts of the same individual. Thus in one

measured the septa are 6 lines apart at a place where the diameter is 16 lines, while they are only 4 lines distant where

Fig. 1.



Endoceras Wahlenbergi.—*a*, portion of the septate part of the shell (nearly one third of it), with some of the smooth inner shell-layer remaining, natural size (*s*, siphuncle); *b*, portion of the test of another specimen, natural size; *c*, part of section from fragment of a large specimen, showing siphuncle (*s*) and sheath (*sh*), natural size; *d*, section and siphuncle of young individual, natural size; *e*, diagram to show average rate of tapering of the species.

the diameter has increased to 19 lines. But on the whole the septa increase their distance as the individual advances in age. Siphuncle proportionately larger in the young than in the adult, as is frequently the case in the testaceous Cephalopods; that is to say, it attains to nearly half the diameter in the young shell (fig. 1, *d*), while in the adult it measures only about one third of the diameter (fig. 1, *c*). Test consisting apparently of two layers, the inner one being perfectly smooth and polished, whilst the outer, the surface of which is rarely preserved, is ornamented with transverse, irregular, slightly oblique riblets (fig. 1, *b*).

Remarks. The "*Orthoceras commune*" of Boll (not Hisinger), which I believe to be identical with *Endoceras Wahlenbergi*, is described by that author as having the "shell in well-preserved examples marked with obscure lines of growth, and in badly preserved ones these are so eroded that their sculpture can scarcely be recognized;" the latter is unfortunately the condition of most of the specimens in the National Collection.

It has been a matter of great difficulty to me to select out of the numerous and divergent forms described and figured under the name of "*Orthoceras duplex*" those whose characters harmonized sufficiently with the species I have now instituted, to justify their incorporation with it. The descriptions of "*O. duplex*" have often been based upon imperfect fragments, consisting of casts, or even of sections only, of a few of the chambers, in which the distinguishing characters are necessarily reduced to a minimum. In some instances the siphuncle only has been figured.

In such circumstances I cannot vouch for the accuracy of all the references given above. The dubious ones are indicated by a note of interrogation.

Amongst the specimens of *E. Wahlenbergi* from Westrogothia two attain a considerable size, the longest measuring 1 foot 7½ inches, the diameter at the larger end being 2½ inches and at the smaller end 10 lines. The other measures 1 foot 5 inches in length, with a diameter of 2 inches and 8 lines at the larger extremity and 14 lines at the smaller, where it is broken, the chambers being here filled with coarsely crystalline calcite (fig. 1, *a*). A marble slab from Sweden contains a section of an *Endoceras* in which a portion of the body-chamber is preserved. This individual measures 2 feet 7¼ inches in length and increases very slowly in diameter, measuring only 1 line at the apical and 1 inch at the basal extremity. On the whole it would seem to belong to a

more slender and slowly tapering species than *E. Wahlenbergi*.

It is difficult to conceive how shells of such great length and thinness of texture could have been preserved from fracture even during the lifetime of the animal. Professor Whitfield, of New York, who has had exceptional opportunities of studying the shells of *Endoceras* in the rich deposits of the Trenton Limestone, as well as in the splendid collections preserved in the American Museum of Natural History, affirms that he finds them "nearly always in a fragmentary condition, the earlier parts having been broken away or otherwise destroyed;" and he supposes that the sheaths formed within the siphuncle served to protect that part of the body of the animal which extended back into it in a "long finger-like projection." The sheaths, he adds, "were not only formed in case of accidents already having taken place, but were probably often formed to guard against future troubles; consequently we sometimes find them crowded together, so as to leave not more than an inch or so between them, and the intervening space filled with coarsely crystalline calc-spar, showing that the one below had not been injured so as to admit the access of foreign matter, which is always sure to be the case where injury has occurred to the individual sheath below the cavity so filled."

With reference to the number and disposition of the sheaths Professor Whitfield observes that in the American species he can "find no regularity whatever in the distances at which they occur even in the same individual. They often occur quite close together, sometimes three or four of them being ensheathed within each other; and others again will have from 10 to 20 inches between them; and I have seen examples of the shell from 2 to 4 feet long without a trace of a sheath" *.

This species resembles in some respects, as in the distance of the septa, and the proportionate size of the siphuncle, *Endoceras belemnitiforme*, Holm (Paläont. Abhandl. 1885, Bd. 3, Heft i. p. 5); but in the latter the septa are said to be equally distant from the very commencement of the shell, which is not the case with the present species, in which the septa are much closer together in the apical portion of the shell than they are at later stages of its growth.

The rare preservation of the apical end of these long and finely pointed shells will always make any characters founded upon the form of the apex but seldom available for purposes

* Bull. American Mus. Nat. Hist. no. 1, New York, Dec. 23, 1881, p. 20.

of specific distinction; and even when the apex is fortunately preserved, as in Holm's species, I hold that such structures, connected as they admittedly are with embryonic development, have too wide an import to be employed in such a way.

Horizon. *Orthoceras*-Limestone (=Arenig *).

Localities. Uitby, near Lake Siljan, and Kinnekulle Hill (Westrogothia), Sweden; Reval (Esthonia), Russia.

Orthoceras kinnekullense, sp. nov.

Sp. char. Shell elongate, tapering at the rate of 1 in 9. Cylindrical in cross-section. The septa direct, distant about $\frac{1}{3}$ the diameter, strongly arched, their convexity about $\frac{2}{5}$ that of their diameter. Siphuncle a little eccentric, about 3 lines in diameter where the shell has a diameter of 21 lines. Test ornamented with regular, direct, flattened, transverse riblets, divided by narrow interspaces. Body-chamber unknown.

Remarks. The most characteristic feature in the present species is the sculpture of the test, which is beautifully preserved on most of the specimens that have come before me. The figure (2, *b*) will enable the reader to realize the sculpture of the shell much better than a verbal description can do. It is necessary, however, to state that the riblets vary in width, so that in some places nearly five of them are contained in the space of 1 line, while in others, especially at the larger extremity of the shell, only about two and a half are required to fill that space. Ordinarily about four to four and a half are contained in one line. These measurements include the interspaces. It will be understood from this that the ornamentation of the test is visible to the naked eye.

The dimensions of the largest specimen in the national collection (fig. 2) are as follows:—length 11 inches, greatest diameter 2 inches, least diameter 1 inch. Septa about $\frac{1}{2}$ inch apart, but becoming a little closer near the smaller extremity of the shell.

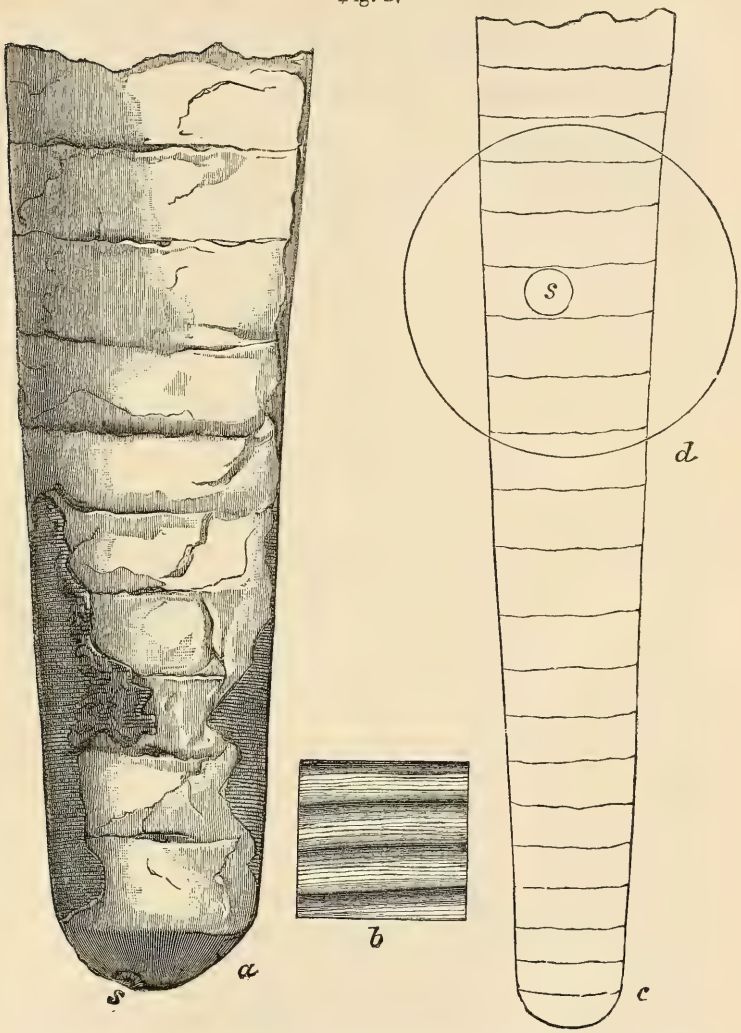
The very characteristic ornamentation of this species separates it from all other Ordovician species known to me.

Horizon. *Orthoceras*-Limestone (=Arenig).

Localities. Kinnekulle Hill (Westrogothia), and Oeland, Sweden.

* See a valuable paper by Prof. F. Schmidt, of St. Petersburg, "On the Silurian (and Cambrian) Strata of the Baltic Provinces of Russia, as compared with those of Scandinavia and the British Isles," in Quart. Journ. Geol. Soc. vol. xxxviii. p. 514 (1882); also J. E. Marr, 'On the Classification of the Cambrian and Silurian Rocks,' pp. 74 and 82 (1883).

Fig. 2.



Orthoceras kinnekullense.—*a*, fragment of the septate part of the shell (about one half of it), with some of the test remaining, natural size (*s*, siphuncle); *b*, portion of the test, greatly enlarged; *c*, outline of the entire specimen reduced one half; *d*, outline of section, restored from another specimen, showing siphuncle at *s*.

Orthoceras revalense, sp. nov.

Sp. char. Shell straight. Section elliptical, the ratio of

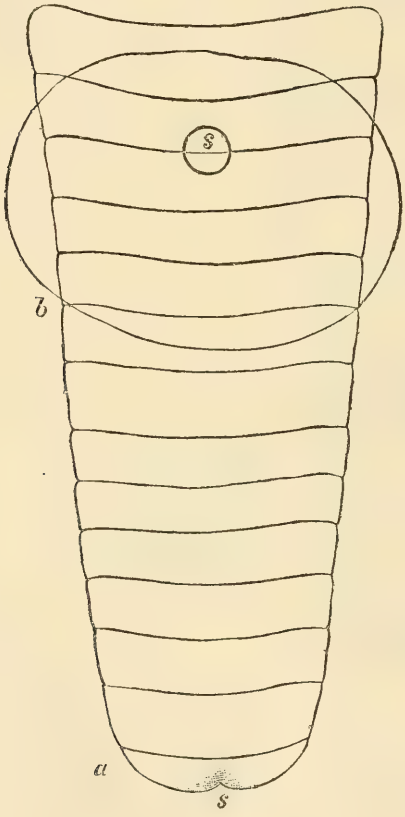
the diameters being as 24 : 19. Very uniformly tapering at the rate of 1 in 6. Septa direct, undulating; distant about $\frac{1}{5}$ the diameter. Siphuncle eccentric, cylindrical, its diameter about $\frac{1}{8}$ the longer diameter of the shell. Body-chamber and test unknown.

Remarks. The distinguishing feature of this species (fig. 3) is its relatively high rate of tapering.

Horizon. *Orthoceras*-Limestone (=Arenig-Llanvirn).

Locality. Reval (Esthonia), Russia.

Fig. 3.



Orthoceras revalense.—*a*, part of a specimen, the whole of which measures $7\frac{1}{2}$ inches (*s*, siphuncle); *b*, section, showing siphuncle at *s*. Natural size.

LIII.—*Description of a new Species of* Evechinus.

By F. Jeffrey Bell, M.A.

[Plate XVII. figs. 7 & 8.]

There has for some time been known to me a form of the genus *Evechinus* which did not appear to be the same as *E. chloroticus*; as, however, the two specimens in the collection of the British Museum are of small size, and as the habitat is unknown, I have for several years delayed publishing the description in the hope that fresh material would come to hand. I now reverse the policy, in the hope that by directing attention to this undescribed form further information will be supplied by those who may possibly have examples of it under their care, or in their possession.

Evechinus rarituberculatus.

This species may be distinguished from *E. chloroticus* by the following characters:—the primary tubercles are less numerous and less closely packed, there is a great reduction in the number of tubercles found in the interambulacral areas, the actinostome, abactinal area, and anal area are proportionately larger, and the poriferous zone is narrower.

Test discoidal, rather flattened, blackish brown, the prominent primary tubercles of the ambulacral areas faintly greenish. Madreporic plate large; two oculars touch the anal border; one large and distinct tubercle on the ordinary genital plates and a few small tubercles on the oculars. Actinal cuts distinct but not deep; actinostome rather large.

The primary tubercles of the ambulacral area, which are largest at the ambitus, diminish in size more rapidly below than above this line. In a test of rather more than forty millim. in width about fourteen may be counted in each row; the tubercle stands rather towards the ambulacral edge of the plate and has a circlet of miliaries around its base; between the two rows of primary tubercles we find at and below the ambitus two rows of secondary tubercles, one on either side of the middle line; above the ambitus these rows rapidly become obscure. On the outer side of the primary tubercles we find an irregular row of small tubercles, which are largest just below the ambitus and quite lost halfway up the abactinal side of the test; of these one on each plate is distinctly larger than the rest.

In the interambulacral areas, on the actinal face of the test, we find two rows of ordinary primary tubercles, rather closely

packed and gradually and regularly increasing in size as they pass from the actinostome to the ambitus, where they are not, however, as large as the primary tubercles of the ambulacral area; between these there is a single row of secondary tubercles. Above the ambitus the primaries rapidly become smaller or completely disappear, and as much as half the abactinal surface of the test may be completely devoid of primary tubercles, when the plates are covered only by small tubercles, not very regularly arranged.

The auricles are strong, the foramen small, and the connecting-ridge low. The buccal apparatus is injured, but the radius would appear to have a shallow rounded notch.

The spines are of moderate length, greenish in colour except at their tip, which is yellowish; a specimen completely covered with spines would probably have very much the same appearance as *E. chloroticus* (though as compared with most dried specimens the spines are of a darker green), but might be distinguished from it by the greater number of short and the smaller number of long spines.

The following table gives the more important measurements:—

Absolute diam. in millim.	Percentage value of				Porif. zone.	Longest spine.	Number of primary tubercles.
	Height.	Actinostome.	Abactinal area.	Anal area.			
42	50	38	19	..	2·6	..	14
45	46·6̇	37·7̇	18·8̇	8·8̇	2·6	11·5	14

As *E. chloroticus* grows to a considerable size, it is of importance to consider whether the differences indicated in the above description are not those of age; the differences in the proportional size of the actinal and abactinal areas would possibly be less if we had larger specimens of *E. rarituberculatus*; but the character which "leaps to the eyes" is the smaller number of primary tubercles. Fortunately we have already from M. Alex. Agassiz (Rev. Ech. p. 503) some information as to the youthful characters of *E. chloroticus*, and he tells us that in specimens 18 millim. in diameter, or only two fifths the size of one of ours, there were already fourteen coronal plates, which is, I presume, equivalent to

saying that there are fourteen primary tubercles. Nor can the great difference between the species in the number of the secondary tubercles be looked upon as any thing else than a mark of specific distinction. A specimen of *E. chloroticus* of the same size as the larger of the two specimens of *E. rarituberculatus* has the poriferous zone at the ambitus 3 millim. wide.

EXPLANATION OF PLATE XVII. Figs. 7, 8.

Fig. 7. Test of *Evechinus rarituberculatus*, seen from above, nat. size.
Fig. 8. Area marked *a* in fig. 7, magnified $2\frac{1}{2}$ times, to show the arrangement of the tubercles.

LIV.—*On a rare Himalayan Toad*, Cophophryne sikkimensis, *Blyth*. By G. A. Boulenger.

Mr. W. T. Blanford has just presented to the British Museum three specimens (a male, a female, and a young) of a very rare Batrachian described by Blyth in 1854 under the name of *Bombinator sikkimensis*. The two original specimens were obtained in Sikkim by Captain Sherwill and are preserved in the Calcutta Museum. A third specimen, received by the same institution, and noticed by Anderson in 1871, was procured on the Sengalula range, Darjeeling, at an altitude of 12,000 feet. The three specimens now added to the British-Museum collection were collected by Mr. Blanford at Byutan, foot of Yakla Pass, Sikkim, at an altitude of 13,000 feet.

I know of no other preserved specimens. The late F. Stoliczka stated *, it is true, that he obtained a few specimens around Darjeeling at an elevation of about 7000 feet. But on comparing his description with the material now to hand, I come to the conclusion that he mistook the young *Bufo himalayanus* for the *B. sikkimensis*. The reference to Stoliczka's *Bufo sikkimensis* and to the abstract I have given of it in the 'Catalogue of Batrachians' (p. 305) should therefore be transferred to the synonymy of *Bufo himalayanus*, Gthr.

Now as to the systematic position of this Batrachian. Theobald recognized it as belonging to the family Bufonidæ, and created for it a new genus, which he named *Scutiger*, assuming apparently the nuptial excrescences of the male to be a permanent character; in addition to the latter character

* Proc. As. Soc. Beng. 1872, p. 112.

he notices the following as generic :—A hidden tympanum and obsolete eustachian tubes, free toes, and the tongue "parted behind." In the opinion of Anderson the genus *Scutiger* is untenable, and *Bombinator sikkimensis* is referred to *Bufo*, from which it "only differs in its free toes and in its slightly notched tongue." An examination of the pupil and of the skeleton reveals, however, important differential characters, and I have no hesitation in accepting the generic separation, although under a new name, that of *Scutiger* being (I might say fortunately) preoccupied (*Scutigera*, Latreille, Myriopoda, 1802). Besides, I do not consider that genus as by any means closely allied to *Bufo*, but as a connecting form between the Bufonidæ, to which it must be referred on account of the absence of teeth, and the Pelobatidæ, the East-Indian forms of which it approaches in the very strongly dilated transverse processes of the sacral vertebra, which bears but a single condyle for articulation with the coccyx (there are two in all Bufonidæ), and the structure of the sternal apparatus, which is precisely that of *Leptobrachium*, *Xenophrys*, and *Megalophrys*. In some of the external characters also (pupil, tongue, toes) it bears resemblance to these three genera.

Cophophryne.

Scutiger (non Latr.), Theobald, Cat. Rept. As. Soc. Mus. 1868, p. 83.

Pupil vertical. Vomerine teeth none. Tongue elliptic, free and very slightly nicked behind. No tympanum; eustachian tubes extremely small, scarcely perceptible. Fingers free, toes nearly free, the tips not dilated. Outer metatarsals united. A cartilaginous omosternum; sternum with a slender bony style. Sacral vertebra with very strongly dilated diapophyses, and one condyle for articulation with coccyx.

Cophophryne sikkimensis.

Bombinator sikkimensis, Blyth, Journ. As. Soc. Beng. xxiii. 1854, p. 300.
Scutiger sikkimensis, Theob. *l. c.*
Bufo sikkimensis, Anders. Proc. Zool. Soc. 1871, p. 204.

Head moderate; snout short, rounded, with indistinct canthus rostralis; interorbital space a little narrower than the upper eyelid. Fingers and toes blunt, without subarticular tubercles; first and second fingers equal; an indistinct rudiment of web between the toes; a large, elliptic, very feebly prominent inner metatarsal tubercle; no tarsal fold. The tibio-tarsal articulation reaches the shoulder or the angle of the mouth. Upper parts with large porous warts, which may

form irregular longitudinal series on the back; a narrow parotoid gland, ill-defined above, extends obliquely from the eye to the extremity of the jaws; lower parts perfectly smooth. Olive-brown above, the warts darker and dotted with lighter; a light triangular spot on the forehead, the base between the eyes, the apex touching the lip; loreal regions dark; limbs with dark marblings. Male without vocal sacs. My specimen does not show the copulatory asperities, which, judging from the descriptions, must be much like those of *Rana Liebigii*.

From snout to vent 50 millim.

LV.—*A List of the Reptiles and Batrachians obtained near Muscat, Arabia, and presented to the British Museum by Surgeon-Major A. S. G. Jayakar.* By G. A. Boulenger.

The following list is based upon two collections formed at Muscat by Mr. Jayakar; the first was received in December 1885, the second in November 1887. The herpetological fauna of the west coast of the Persian Gulf being very imperfectly known, these collections are of particular interest.

REPTILIA.

Chelonia.

1. *Testudo stellata*, Schweigg.
2. *Chelone virgata*, Schweigg.

Lacertilia.

3. *Ceramodactylus Doriæ*, Blanf.
4. *Alsophylax tuberculatus*, Blanf.
5. *Hemidactylus Coctœi*, D. & B.
6. *Agama sinaita*, Heyd.
7. *Agama isolepis*, Blgr.
8. *Uromastix spinipes*, Daud.
9. *Varanus griseus*, Daud.
10. *Lacerta Jayakari*, Blgr.

Four specimens have been received since the publication of this species (Cat. Liz. iii. p. 40, pl. ii.). They agree so well with the description I have given that it is sufficient to record the following notes on the number of scales and femoral pores:—

	♂.	Hgr. ♂.	♀.	♀.
Dorsal scales across the middle of the body	85	86	93	86
Transverse series of ventrals	28	28	29	29
Femoral pores, on each side	29	27	25	25

11. *Scincus muscatensis*, Murray.

12. *Chalcides ocellatus*, Forsk.

OPHIDIA.

13. *Zamenis ventrimaculatus*, Gray.

14. *Zamenis diadema*, Schleg.

15. *Lytorhynchus diadema*, D. & B.

16. *Psammophis Leithii*, Gthr.

17. *Dipsas obtusa*, Reuss.

18. *Hydrophis robusta*, Gthr.

19. *Hydrophis Elliotti*, Gthr.

20. *Hydrophis cyanocincta*, Daud.

21. *Hydrophis Jayakari*, sp. n.

Head rather small, snout moderate. Body of moderate length, slender anteriorly. A single postocular; suture between the prefrontals extremely short, not one fourth the length of that between the nasals; frontal more than twice as broad as the supraocular, hexagonal, the lateral sides shortest, not half as long as the posterior, which are the longest; suture between the parietals as long as the frontal; a single, large, anterior temporal; two pairs of chin-shields, in contact mesially, posterior pair largest. Scales juxtaposed, dorsals obtusely keeled; 27 scales round the neck, 37 round the body. Ventral shields thrice as broad as the adjoining scales on the neck, hardly twice as broad as those on the body, 260 in number. Four præanal shields, outer largest. Uniform plumbeous above; upper lip, sides, and lower parts white.

Total length 640 millim.; tail 75; diameter of neck 11; greatest vertical diameter of body 32.

A single specimen.

22. *Enhydrina bengalensis*, Gray.

23. *Echis carinata*, Schn.

24. *Echis colorata*, Gthr.

BATRACHIA.

25. *Bufo Andersonii*, Blgr.

LVI.—*Notes on* Argonauta Böttgeri.

By Edgar A. Smith.

[Plate XVII. figs. 1–6.]

The shell of this species was described and figured by Maltzan in the 'Journal de Conchyliologie,' 1881, p. 163, pl. vi. fig. 7. He does not state whence his specimens came. In the British Museum there are two examples forming part of the Cumingian collection marked "Australia" and three from "Masbate, Philippines." Two specimens from the Mauritius were obtained from Mr. Robillard, one from the China Seas has lately been acquired, and two others have recently been presented by J. F. Keene, Esq., who captured them near the Chagos Islands in the midst of the Indian Ocean.

The distinguishing features of this species are the numerous ribs and tubercles, the total absence of auricular expansions at the sides, its constantly small size, and the fine granulation (a feature not remarked upon by Maltzan), which more or less covers the whole surface, producing a dull non-glossy appearance. These granules are particularly dense on each side near the axis.

The tubercles upon the keels, which, as in all species of *Argonauta* with the exception of *A. argo*, alternate in the two series, vary to some extent both in prominence and number. In figure 1 (a copy of Maltzan's figure) the tubercles are numerous and moderately prominent; in figure 3 they are as numerous but less feebly developed, and figure 2 represents the opposite extreme, in which the tubercles are fewer, distant, and striking.

The following table, including the series of specimens in the Museum and that represented by von Maltzan, will indicate the variation in the number of the tubercles:—

	Greatest diameter in millim.	Number of tubercles.
From Masbate, Philippines	40	33
Maltzan's specimen	36	28
From Australia	33	24
From Masbate	33	22
From Australia	33	21
From China Seas	30	18
From Mauritius	28	17
Near Chagos Islands	28	14
From Mauritius	27	16
From Masbate	24	16

The animals obtained by Mr. Keene are in a somewhat poor state of preservation, and therefore admit only of partial description. The body appears to be rather more than twice as long as broad, of about equal breadth throughout, but somewhat narrowed at the posterior dorsal extremity. It is of a dirty buff tint, ornamented with numerous dots, spots, and rings of a purple-black colour, which is much darker on the dorsal than on the ventral surface. The arms are also marked with scattered minute dots and rings. The dorsal pair are a trifle the thickest and longest, the third pair almost if not quite as long, and the second and fourth pairs shortest.

No idea of the expansions of the dorsal arm, which serves for the retention of the shell, can be obtained, owing to the condition of the specimens; it is evident, however, that scarcely any interbrachial web exists at the base of any of the arms.

The beak is strong and coal-black. The lower mandible is but very little produced or beaked; the upper one is a trifle smaller and narrower, but not acutely pointed. The suckers on all the arms are raised on thick peduncles, which are not contracted at the base, and those towards the base are the largest, the rest gradually decreasing in size towards the extremities. On what is left of the third pair of arms there are seventy-two, alternating in two series of thirty-six; but this number is not likely to be constant.

The teeth, as usual, are in seven rows; the median tooth is broad at the base and tricuspid, the central cusp being acuminated and very much longer than the lateral cusps; the next or first lateral tooth has a broad base, occupying about half the total length, is then narrowed and pointed; the two outer laterals are larger than the rest and somewhat curved and tapering, the outermost being rather narrower at the base than the other.

The ova contained in one of the shells are very numerous, probably some hundreds in number, of a yellowish-white colour, and occupy about half the shell. They are connected into one mass by extremely fine hair-like filaments. They are not all of exactly the same size, but average almost 1 millimetre in diameter.

The shell of this species must not be confounded with the young stages of *A. hians*; the more numerous ribs and tubercles and the rougher granular surface will separate it. The animal also has a different radula and other distinguishing characters. The teeth of a specimen of *A. hians* which I have examined closely resemble those of *A. argo* (*vide* d'Orbigny and Férussac, Hist. nat. Céphalop. pl. i.

fig. 9), the median tooth being simple and spine-like, and not tricuspid, as in *A. Böttgeri*.

Maltzan compares his shell with *A. Owenii* of Adams and Reeve; but that unsatisfactory form I am inclined to locate, as has been done by von Martens (Ann. & Mag. Nat. Hist. 1867, vol. xx. p. 105), with the varieties of *A. hians*.

EXPLANATION OF PLATE XVII. Figs. 1–6.

Figs. 1, 2, 3. Lateral view of three specimens of the shell of *Argonauta Böttgeri*, showing variation in the number and prominence of the tubercles.
Fig. 4. The lower mandible of the beak.
Fig. 5. The upper mandible.
Fig. 6. A single row of teeth of the odontophore.

LVII.—*Note on the Variations of* Amphiura Chiajii, *Forbes.*

By F. Jeffrey Bell, M.A.

Dr. John Murray, F.R.S.E., while dredging off the west coast of Scotland, collected a large number of examples of *Amphiura Chiajii*, which he has been so good as to present to the Trustees of the British Museum. An examination of these and a comparison of them with the accounts given by preceding writers reveal a wide range of variation. As the variations of described species are now recognized as being much more important and interesting than the descriptions of new forms, I make no apology for directing attention to this Ophiurid.

The first point to which attention may be directed is the length of the arms. Mr. Norman, in his well-known paper on British Echinoderms *, gives as one of the characters of the species, "Arms extremely long and very slender," or uses an expression which is verbally similar to that which he applies to the eminently long-armed *A. filiformis*. Among the specimens collected by Mr. Murray there are none which justify the use of the adverb "extremely;" on the other hand, Forbes's remark that the length of the arms varies in different specimens is certainly confirmed by the numerous specimens collected off the west coast of Scotland.

The arms of young forms are perhaps proportionately

* 'Annals,' [3] xv. p. 107.

longer than those of older specimens; thus the length of the arms was about five times the diameter of the disk in a specimen whose disk-diameter was 5 millim., and four times that of the disk when the disk-diameter was 8 millim.; on the other hand, a specimen whose disk-diameter was 9 millim. had an arm nearly 70 millim. long, but *this, which was the only complete arm on the specimen, was for the greater part restored.*

The process of restoration, indeed, may be observed in almost every specimen, and an examination of one will enable us to estimate the value of the character, which, in his "Key" to the species of *Amphiura* *, Mr. Lyman gives as a distinguishing characteristic of *A. Chiajii*—" a notch in outer side of under arm-plates."

If we take an arm which, by the darker colour of its proximal and the lighter colour of its distal portion, indicates that it is a ray which has undergone repair, we shall find a marked difference between the under arm-plates of the old and the new joints. The former will be seen to have three sides very nearly even, as even, at any rate, as plates that were notched at an earlier stage may be expected to have them; but the latter will be found to be constricted from side to side and to be more or less emarginulated along their distal edge.

The extent to which these notches at the edges of the plates become filled up depends first of all on age, and secondly, no doubt, on the amount of carbonate of lime which the individual *Amphiura* is able to appropriate to the strengthening of its delicate skeleton.

Forbes's remark that the lower plates are longitudinally sulcated is, so far as my experience goes, a character that is so constant that it should not be omitted in any definition of the genus.

The comparative length of the arms and the extent of calcification of the under arm-plates are not the only points in which examples differ. Specimens collected at one spot and preserved in the same manner differ in the form of the disk, which may be nearly circular or may be more or less deeply incised or angulated in the interradial areas. The extent to which the apical and the central plates are obvious is another point in which, as a rule, young differ from old specimens; as may be supposed, it is in the former that these significant plates are best marked. Another character which presents differences, and generally, though not always, differences with age, is the general coloration of the body; if we take a speci-

* 'Challenger' Report on Ophiurids, p. 123.

men which has undergone repair of the arms we find that the restored portions are of a much lighter colour than the rest of the animal.

As to the cause of the considerable variations here noted I can offer no suggestion: though Dr. Murray dredged in various lochs, and noted certain differences in the fauna, I have not yet any evidence that the variations of *A. Chiajii* have any obvious relation to difference of locality; specimens taken at one spot differ greatly among themselves.

LVIII.—*Description of a new Snake from Afghanistan.*

By G. A. Boulenger.

Lytorhynchus Ridgewayi.

Head small, distinct from neck; snout pointed, strongly projecting. Rostral very large, four-sided; the lower side longer than the upper, deeply concave; the lateral sides angularly emarginate, concave, with a trace of a short longitudinal cleft; the posterior angle wedged in between the pair of frontonasals, which form a short suture. A single præfrontal, twice and a half as broad as long; frontal large, pentagonal, a little longer than broad, its straight anterior border twice as long as the greatest width of the supraoculars; parietals slightly longer than the frontal; nostril very indistinct, but, by pressing, fluid is expelled from the upper half of the oblique suture between the two nasals; of the latter shields the anterior is more than twice as large as the second; a small loreal; three præoculars, upper largest and in contact with the frontal; a subocular; two or three postoculars; seven upper labials, none in contact with the eye, three posterior largest; two anterior temporals, upper smallest; three or four temporals in contact with the parietal. Six infralabials on each side in contact with the chin-shields, the posterior pair of which is the smallest and separated by two pairs of scales. Nineteen rows of scales. Ventrals 174; anal divided in one specimen, single in the other; subcaudals 46 pairs. Upper surfaces pale buff, with brown, black-edged, symmetrical markings; an anchor-shaped marking on the head, the crescentic portion extending from one angle of the mouth to the other, passing through the eye and crossing the frontal and præfrontal; the longitudinal branch expands in a large

spot on the middle of the parietals, and bifurcates on the nape; large transverse spots disposed at regular intervals on the body and tail, and alternating with smaller ones on the flanks; lower parts uniform white.

Total length 425 millim.; tail 70.

Two specimens from Chin-Kilak, Afghanistan, collected by Dr. Aitchison, on the Afghan Boundary Commission.

Named after Sir J. W. Ridgeway.

Unless this species be made the type of a new genus, on account of the coalesced præfrontals, it is difficult to decide whether to refer it to *Lytorhynchus* or to *Acontiophis*. But I am satisfied that both genera should be united, as they agree in every important point, and particularly in the dentition, the structure of the nostril, and the (vertical) shape of the pupil. The synonymy of the genus *Lytorhynchus*, as understood by me, is as follows:—

Lytorhynchus, Peters, Mon. Berl. Ac. 1862, p. 272.
Chatachlein, Jan, Elenco, p. 45, 1863.
Acontiophis, Günth. Proc. Zool. Soc. 1875, p. 232.
Catachlæna, Blanf. Proc. Zool. Soc. 1881, p. 678.

LIX.—*Descriptions of two new Species of* Hyponomeutidæ *from the Solomon Islands.* By A. G. Butler, F.L.S., F.Z.S., &c.

The two following species of moths formed part of Mr. Woodford's recent consignment.

Corinea rex, sp. n.

Allied to *C. aurata*, but the primaries, basi-abdominal half of secondaries, and body of a bright coppery metallic golden colour, the external sixth of primaries brilliant purplish black, the apical half of secondaries smoky greyish, with a cupreous lustre in certain lights; costa silvery white: head, pectus, and legs chocolate-brown, spotted with white: primaries below largely suffused with brown, which, however, changes to golden in certain lights. Expanse of wings 26 millim.

Alu.

Corinea Mathewi, sp. n.

Allied to *C. basalis* of Vollenhoven (Tijd. voor Ent. vol. ii. pl. ix. fig. 5, 1863); it differs as follows:—basal half only of

all the wings golden ochreous, outer half greyish chocolate, glossed with purple; the silvery white spots on primaries quite different, the first rather small, towards base of dorsal margin, the second obliquely in front of it within the cell, the third forming a transverse band (not invariably reaching the costa) before the middle; the fourth transverse, quadrate, beyond the cell; the fifth quadrate, bifid, costal, subapical; the sixth large, broad, its inner edge slightly arched, its outer edge angulated, and its base on dorsal margin near external angle; the seventh oval, small, subapical, halfway between the last two spots and the outer margin; a few other white dots are scattered along the costa and between the outer spots: head white, antennæ brown, collar spotted with white behind; palpi with brownish terminal joint; legs white, anterior pair brownish in front; pectus white, with two brown spots on each side, venter white, basal half of anal valves golden ochreous, outer half smoky brown: wings below pale, as if washed out. Expanse of wings 33 millim.

♂ ♀. Malayta (*Woodford*).

This species was also collected by Mr. Gervase Mathew and is now in Lord Walsingham's collection, on which account I should have preferred for his lordship to describe the species; but for various reasons he thought it better that I should complete the series of descriptions of Mr. Woodford's Lepidoptera, which I had begun.

LX.—*Descriptions of two new Species of* Cicadidæ.

By W. L. Distant.

Cryptotympana sinensis, n. sp.

♂. Head ochraceous; front with the margins (but not meeting at apex) broadly castaneous; eyes olivaceous; ocelli reddish ochraceous, with their surrounding area castaneous. Pronotum castaneous, the margins and a central fascia, which is much widened and ampliated at base, ochraceous. Mesonotum ochraceous, with two large obconical castaneous spots near each lateral margin and two large, central, very obscure obconical spots, which are only visible by their slightly darker margins; basal cruciform elevation pale olivaceous. Abdomen above ochraceous, the posterior segmental margins castaneous. Body beneath and legs ochraceous; face with the

lateral carinæ castaneous; apices of the tibiæ and tarsi castaneous. Tegmina pale hyaline, the venation ochraceous, the costal membrane pale greenish, and the basal third of the tegminal area tinged with pale ochraceous. Wings pale hyaline, the venation ochraceous, and the base narrowly tinged with pale ochraceous.

The face is tumid, the lateral carinæ robust and slightly waved; the rostrum extends to the intermediate coxæ; the opercula are somewhat short, with their lateral margins slightly concave and their posterior margins oblique; they overlap at the centre and their apices extend to the second abdominal segment.

Long. excl. tegm., ♂ 40 millim., exp. tegm. 118 millim.

Hab. Shantung, North China.

Cryptotympana insularis, n. sp.

Head, pronotum, and mesonotum dark olivaceous; eyes ochraceous, front with some basal black carinæ on each side of lateral margin; ocelli shining ochraceous. Pronotum with a pale central longitudinal impression with some short transverse carinæ at base, and with two oblique linear incisions on each lateral half. Mesonotum with two dark central obconical spots starting from anterior margin, and on each side of these spots is a smaller and more obscure spot; a dark castaneous spot in front of the basal cruciform elevation, which is pale olivaceous. Abdomen above dark shining brownish olivaceous, the segments more or less clothed with pale pilosity. Body beneath olivaceous; face with a central, longitudinal, levigate, ochraceous fascia, which is somewhat obliterated near centre; rostrum pitchy and almost reaching the posterior coxæ; abdomen beneath brownish ochraceous; legs with the anterior femora dark ochraceous, their apices and the anterior tibiæ and tarsi pitchy; intermediate and posterior femora brownish, the trochanters pitchy, the tibiæ ochraceous, their apices and the tarsi pitchy, the posterior tarsi with a central ochraceous annulation. Tegmina pale hyaline, with a very slight fuscous tinge; venation and the costal membrane olivaceous, the first more brownish on basal half, and the transverse veins at the apices of the two upper ulnar areas infuscated. Wings resembling tegmina, both narrowly very dark fuscous at bases.

The body is short and broad, giving the species much the appearance of the American genus *Fidicina*. The opercula slightly overlap at the centre, and are obtusely and broadly

angulated at the apices, which do not pass the broad basal segment of the abdomen. Anterior femora armed beneath with two strong spines, one near base and one near apex.

Long. excl. tegm., ♂ 36 millim., exp. tegm. 115 millim.

Hab. Andaman Islands, Port Blair (*Meldola*).

LXI.—*Studies on the* Enchytræidæ.

By Dr. W. Michaelsen *.

[Plate XVIII.]

As regards the systematic arrangement of the family Enchytræidæ we have before us two different modes of treatment:—1. Claparède's old division into the genera *Enchytræus*, Henle, and *Pachydrilus*, Clap.†, to which the genera *Anachæta*, Vejdovsky, *Distichopus*, Leidy, and *Buchholzia*, aut., were subsequently added; and 2. The newer classification by Eisen into the three genera *Mesenchytræus*, *Archienchytræus*, and *Neoenchytræus* ‡.

Eisen founds his classification in the first place upon the form of the cerebrum, having previously amalgamated the genera *Enchytræus* and *Pachydrilus*. In justification of this amalgamation he says:—"It is evident, as Ratzel and others have shown, that the colour of the blood is hardly a character of sufficient value to permit us to found on it the distinction of genera;" and he adds, "It may also be remembered that one of Claparède's species, *Pachydrilus lacteus*, has white blood, and that not all red-blooded live in water." The conclusion deduced from this statement would be justified if the colour of the blood and residence in water were actually the only points in which the *Pachydrili* differ from the other Enchytræidæ. But this is not the case. There are other essential characters by which the red-blooded Enchytræidæ are characterized as a perfectly natural group which may

* Translated by W. S. Dallas, F.L.S., from a separate copy, forwarded by the Author, of his paper entitled "Enchytræiden-Studien," published in the 'Archiv für mikroskopische Anatomie,' Band xxx. pp. 366–378 (1887). The numbers attached to the Author's notes have been retained in parentheses in all cases where the titles of works or memoirs are given. This will facilitate reference throughout the paper.

† (1) Claparède, 'Rech. Anat. sur les Annélides, Turbellariés, Opalines et Grégarines' (Geneva, 1861).

‡ (2) Eisen, "On the Oligochæta collected during the Swedish Expeditions to the Arctic Regions, in the years 1870, 1875, and 1876," in Kongl. Svensk. Vet.-Akad. Handl. Bd. xv. 1877 (Stockholm, 1877–79).

claim generic rank. They have S-shaped setæ and are destitute of the salivary glands. As the first thing, therefore, I show that the genus *Pachydrilus*, Clap., must be maintained.

Not to be unjust towards Eisen, I must state that the incompleteness of Claparède's generic diagnoses and the inconsistencies of which that author was guilty in the arrangement of his species in the respective genera could not but cause the soundness of the latter to appear doubtful, especially to a naturalist who had only preserved materials to work upon, and could not by his own investigations learn the coincidence of the principal character indicated by Claparède, the colour of the blood, with other essential peculiarities. The reproach of inconsistency relates to the position of Claparède's *Pachydrilus lacteus*, which, indeed, plays an important part in Eisen's statement. This Enchytræan does not belong at all to the genus *Pachydrilus*, as appears from Claparède's own statements. It possesses colourless blood and "Les aiguilles sont parfaitement rectilignes, à l'exception de l'extrémité interne, qui est recourbée de manière à former un petit crochet" (1, p. 17). With *Pachydrilus proximus*, Czern.*, *Enchytræus Möbii*, aut.†, and *E. spiculus*, Leuck.‡, it forms a group of *Enchytræi* which could be arranged with the *Pachydrili* only on account of their marine habitat. The circumstance that they possess no dorsal pores is not of consequence, for many other species of *Enchytræus* want these without their position being thereby rendered doubtful.

The question now arises whether Eisen's system is to be completely rejected, or whether it may not be combined with

* (3) Czerniavsky, "Materialia a. zoograph. pontic. comparat.: Fasc. iii. Vermes," in Bull. Soc. Imp. Nat. Mosc. 1880, no. 2.

† (4) Michaelsen, 'Ueber *Enchytræus Möbii* und and. *Enchytræen*,' Kiel, 1886.

‡ (5) Frey und Leuckart, 'Beiträge zur Kenntniss der wirbellosen Thiere.' (Some time since my father sent me from Cuxhaven three living specimens of a whitish Enchytræid, about 10 millim. in length, which is undoubtedly identical with *E. spiculus*, Leuck. They possess delicate straight setæ, only a little bent at the inner extremity, standing in tufts of 4–6 (on the anterior segments often even 7–8) together. The cerebrum is posteriorly deeply emarginate, with the lateral margins converging in front, and it is rather longer than broad. The seminal funnels are broad, barrel-shaped, with the margins everted. A mature ovum exceeds the others considerably in size and occupies nearly the whole of the body-cavity in the twelfth segment. These worms, therefore, probably lay only one egg in each cocoon, unlike the other marine Enchytræidæ with which I am acquainted (see 4, pp. 8–9). The seminal pouches consist of a simple, thin-walled, pyriform principal part and a rather short, simple, straight, efferent duct. The worms were found below Cuxhaven outside the dyke, upon the ground overflowed by the sea at flood-tide.)

Claparède's. In order to decide upon this point I have subjected Eisen's genera to a thorough revision, in which it was no small advantage to me that I was able personally to investigate most of the species worked at by Eisen, and to compare them with the Enchytræidæ of our fauna. I take this opportunity of offering my best thanks to M. Gustav Eisen and to Prof. Sven Lovén, by whose kind intervention I was enabled to make these investigations upon the valuable arctic materials.

I arrived at the following result. Eisen's chief principle of classification, the more or less advanced fusion of the two halves of the cerebrum, when applied in too one-sided a fashion, leads to the establishment of unnatural genera. As such I must characterize the genera *Archienchytræus* and *Neoenchytræus*, which are separated from each other only by the form of the cerebrum. As evidence of the insufficiency of this principle of classification I may cite the two species of the genus *Buchholzia*, which will be treated in detail further on; their near relationship must strike every one who compares them. But according to the form of the cerebrum *B. appendiculata*, Buchh., must be referred to *Mesenchytræus*, while *B. fallax*, aut., possesses the cerebrum of an *Archienchytræus*. It would, however, be wrong to deny that the form of the cerebrum is of essential importance in some respects. In the second line we must assign it a certain significance in many Enchytræid-groups. Thus the two known species of the perfectly natural genus *Anachæta*, Vejd., possess an almost exactly similar *Neoenchytræus*-cerebrum. In those *Enchytræi* also which group themselves around *E. hegemon*, Vejd.*, and which are distinguished by the constant presence of dorsal pores, by the unequal length of the setæ in the same tuft, and by the occurrence of lateral sacs on the *receptaculum seminis*, the *Neoenchytræus*-cerebrum predominates. (*E. lobifer*, Vejd., alone, according to that author, possesses a posteriorly emarginate cerebrum †.)

Further, those *Pachydrili* of which we know the form of the cerebrum, with the exception of *P. fossor*, Vejd. (*loc. cit.* pl. xiii. fig. 9), possess a cerebrum deeply emarginate at the posterior margin. Lastly, I might in this place cite a fourth natural group of Enchytræidæ in which a definite form of cerebrum is characteristic; but it first of all needs to be

* *E. hegemon*, *E. galba*, *E. Leydigii*, *E. lobifer*, *E. Perrieri*, Vejd., and *E. teniis*, aut.

† (7) Vejdovsky, "Beitr. z. vergl. Morphol. d. Anneliden: I. Monographie der Enchytræiden" (Prague, 1879), pl. ix. fig. 3.

proved that the group is a natural one. I refer here to the genus *Mesenchytræus*, Eisen, which occupies a special position in Eisen's system, inasmuch as it is not founded, like the other two, solely upon the form of the cerebrum. In what follows I indicate the results of my comparative investigations upon Eisen's and the German *Mesenchytræi*. To this I shall append a description of the genus *Buchholzia*, so as then to pass to the establishment of a system of the Enchytræidæ such as, in my opinion, gives the best expression to the relationships existing in this family.

Genus Mesenchytræus, Eisen (2).

Enchytræus (*Mesenchytræus*), Vejd.*
Pachydrilus (*Mesenchytræus*), aut. (4).

The *Mesenchytræi* are Enchytræidæ with strongly sigmoidally-curved setæ (Pl. XVIII. fig. 1, *a*), without dorsal pores or salivary glands. They possess a large, distinctly recognizable cephalic pore, which is situated at the apex of the head-lobe or close to it, as has been described by me in *M. Beumeri* (4, p. 19, and 6, fig. 14). In this way they are essentially distinguished from the *Pachydrili*, in which the cephalic pore is small, and placed in the dorsal median line between the head-lobe and the cephalic ring. Eisen unfortunately has stated nothing about head-pores; but by means of serial sections I have been able to make out with certainty that in this respect *M. primævus* and *M. falciformis* exactly agree with *M. Beumeri*. Of three specimens of *M. mirabilis* which were at my disposal, the cephalic extremity had unfortunately been cut away behind the zone in two of them, while the third showed a slight injury to the head-lobe. Nevertheless I believe that in this last specimen I recognized a cephalic pore near the anterior margin of the head-lobe, but I cannot assert positively that I was not deceived by an artificial production. The *Mesenchytræi* (judging from our native species) possess colourless blood and a cardiac body, like that of many Polychæta, such as *Terebellides Strömii* and *Pectinaria belgica* †. Firmly attached to the inside of the wall of the vessel in the ventral median line, this traverses the whole of the dorsal vessel. It consists of cells of various sizes with distinct cell-walls and nuclei and a fine protoplasmic granulation. In *M.*

* (8) Vejdovsky, 'System. und Morphol. der Oligochæten,' Prague, 1884.

† (9) Michaelsen, "Ueber Chylusgefasssystem bei Enchytræiden," in Arch. für mikr. Anat. Band xxviii. (Bonn, 1886), p. 301, figs. 10 and 11.

mirabilis (fig. 3 *b*) and *M. primævus* it is thick, with irregular and often strong dilatations, and is multicellular in transverse section. In *M. falciformis*, *M. Beumeri* (fig. 1 *e*), and *M. flavidus* it is thinner, nearly smooth, with only slight dilatations, and exhibits only a few cells in transverse section. I have found a similar cardiac body in no other Enchytræid. It must probably be regarded as an ingrowth of the intestinal epithelium into the dorsal vessel, and therefore as homologous with certain organs in other Enchytræidæ, such as the intestinal diverticulum of the *Buchholziæ*.

The cerebrum of the *Mesenchytræi* (figs. 1 *c* and 2 *b*) is straightly truncated or only slightly concave behind. In front it is more or less deeply emarginate, and upon the anterior branches, which pass over into the commissures, the coating of ganglion-cells extends far forwards, even to the spot where the cephalic nerves branch off. Two pairs of muscles are attached to the cerebrum, one on the upper surface (figs. 1 *c* and 2 *b*, *om*), the other below (figs. 1 *c* and 2 *b*, *um*). At the posterior angles, and leaving these between them, they go off from the brain obliquely backwards, nearly parallel to each other. The segmental organs also exhibit an exceedingly characteristic development (see figs. 1 *d*, 2 *c*, and 3 *a*). They consist of a minute, funnel-shaped, anteseptale, and a large, remarkably irregular postseptale, usually furnished with lobate or capitate excrescences. A relatively wide vibratile canal traverses the anteseptale in a straight line; but in the postseptale it is so much twisted and so closely entwined that here the enveloping cell-substance is reduced nearly to a minimum. The irregular excrescences of the segmental organs have nearly the appearance of hernioidal diverticula of the vibratile canal. In Eisen's figures this characteristic course of the vibratile canal is not to be recognized; but in this respect his species do not differ from the German ones. From fig. 3 *a*, which is the exact representation of a tangential section through a segmental organ of *M. mirabilis*, it will be seen that Eisen (2, fig. 25) has represented the vibratile canal as much too spacious, so that these peculiar structural conditions have not been expressed. This applies also to the figures of the segmental organs of *M. primævus* and *M. falciformis* (2, figs. 24 and 26).

Finally, the sexual organs of the *Mesenchytræi* also exhibit peculiarities. The seminal ducts are short, at the utmost eight times as long as the seminal funnel. The spermatozoa and ova fall into the body-cavity before they have reached maturity, but they do not then float freely about in it. For their reception more or less deep, tubular, or sacciform poste-

rior inversions (spermatozoa-sacs and ovisacs) are formed by the dissepiments XI./XII. (for the spermatozoa) and XII./XIII. (for the ova). *M. Beumeri* possesses two spermatozoa-sacs, which extend, to the right and left of the intestine, as far as the posterior wall of segment XII. In *M. mirabilis* I found only one, which, however, perforates the following dissepiments, and extends into segment XXVI. Within the segments it is dilated; the dissepiments produce narrow constrictions upon it. A median ovisac stretches below the intestine in *M. flavidus* into segment XVII., in *M. Beumeri* and *M. falciformis* into segment XIX., and in *M. mirabilis* even into XXIX. The length of the sac may, however, be different in different individuals of the species. I have given the extremes noted by me. In *M. mirabilis* the ovisac also shows dilatations and constrictions. In *M. Beumeri* and *M. flavidus* it is of uniform thickness throughout. The function of oviducts is performed by two symmetrical funnel-shaped inversions of the dissepiment XII./XIII., which open outwards by transverse slits in the ventral line of setæ, in front of the tufts of setæ of segment XIII. As probably in all Enchytræidæ, with the exception of the genus *Anachæta*, Vejd., the seminal ducts in the *Mesenchytræi* are united and communicate with the intestine. This I have been able to ascertain positively in *M. falciformis*, *M. Beumeri*, and *M. flavidus*.

From all this it appears clearly enough that the genus *Mesenchytræus*, Eisen, is a natural one. As a second point, therefore, I find that it must be received into the system. Although the name *Mesenchytræus* was chosen only in opposition to *Archienchytræus* and *Neoenchytræus*, I will nevertheless retain it without adopting the latter, as the genus *Mesenchytræus* of Eisen's classification exactly coincides with this genus as defined by me.

I have detected two species in the German region, namely *M. Beumeri* and *M. flavidus*.

Mesenchytræus Beumeri, aut. (4).

Pachydrilus (*Mesenchytræus*) *Beumeri*, aut. (4).

I have elsewhere given an accurate description of this worm (4, pp. 44–46). I therefore confine myself to elucidating what was there stated with figures (Pl. XVIII. fig. 1).

As localities I can cite the marshes of the Elbestrand below Flottbeck, near Hamburg, the Borstler Beck on the Baxtehud road behind Harburg, and the Eppendorfer Moor, near Hamburg. It lives chiefly under moss and bark on rotten black tree-stumps.

Mesenchytræus flavidus, nov. spec.,

is a rather dry-skinned worm of a yellowish colour, about 12 millim. in length. Its setæ are like those of *M. Beumeri* (fig. 1 *a*), and there are as many as five in a tuft. The lymph-corpuscles I have been able to observe only in preserved specimens. They are small and appear to be irregularly elongate-oval. The head-pore is situated at the apex of the head-lobe. The cerebrum (fig. 2 *b*) is slightly concave behind, deeply emarginate in front, with parallel lateral margins, and somewhat longer than broad. The segmental organs (fig. 2 *c*) are of irregular form, with the peculiarities above described as characteristic of the *Mesenchytræi*. The blood is colourless; the dorsal vessel originates in segment XIII. The seminal ducts (fig. 2 *d*) consist of a barrel-shaped seminal funnel with an everted margin and a short seminal canal, which is at the utmost five times as long as the funnel. The seminal canal leads into the wider pole of a pyriform penis and opens outwards through its narrower pole. The aperture is beset with small, lobiform, prostate glands. The oviducts are narrow and rather short. The seminal sacs (fig. 2 *a*) possess a simple efferent duct, furnished at its aperture with a slight bulbous dilatation, and a simple pyriform main portion, which communicates with the intestine at its apex. The cingulum, as in *M. Beumeri*, occupies the posterior half of segment XI. and the whole of segments XII. and XIII.

M. flavidus lives in yellow rotten tree-stumps in the Borstler Jäger, near Hamburg, and under moss in woods near Witten a. d. Ruhr in Westphalia.

Genus Buchholzia, aut. (9).

The peculiar circumstance that in the long-known species, first described by Buchholz * as *Enchytræus appendiculatus*, a displacement of the sexual parts has taken place, induced me, as it coincided with other essential peculiarities, to separate this Enchytræid from the genus *Enchytræus*, and to establish for it a distinct genus, to which I gave the name of *Buchholzia*. Investigations upon a species recently discovered by me, which comes so near to *B. appendiculata* that it cannot be separated from it by generic limits, compel me, however, to remove the definitions relating to the peculiarities of the sexual organs from the diagnosis of the genus. The new

* (10) Buchholz, "Beiträge zur Anatomie der Gattung *Enchytræus*," in Schriften d. physikal.-ökon. Gesellsch. z. Königsberg, 1862.

species (which I name *B. fallax*) shows the arrangement of the sexual organs which is normal in the Enchytræidæ. But even leaving out of consideration the definitions in question as given in the diagnosis formerly published, the genus *Buchholzia* must be sustained.

The *Buchholziæ* belong to the section of the Enchytræidæ with sigmoidally-curved setæ. They possess no dorsal pores, but have a head-pore, which is situated between the head-lobe and the cephalic ring. The lymph-corpuscles are present in both the known species in two forms (fig. 4 *b*), namely small, limpid, navicelliform, and without a recognizable nucleus, and larger, finely granulated, flat-ovate, with a distinct nucleus. They are the only Enchytræidæ provided with sigmoidally-curved setæ which possess salivary glands. These are very much reduced, stumpy, or at the utmost but little lobed, and they open laterally into the œsophagus, not close behind the pharynx, but further back, in segment IV. The blood is colourless. The dorsal vessel originates in segment VII. from the intestinal blood-sinus, upon a diverticulum produced by growth of the intestinal epithelium. The seminal ducts are long. The oviducts (judging of the whole genus from observations on *B. fallax*) are as I have found them in the other Enchytræidæ. The seminal sacs communicate with the intestine.

Buchholzia appendiculata, Buchholz.

Enchytræus appendiculatus, Buchholz (10).
Enchytræus (*Mesenchytræus*) *appendiculatus*, Vejd. (7 and 8).
Enchytræus (*Mesenchytræus*?) *appendiculatus*, aut. (4).
Buchholzia appendiculata, aut. (9).

The accurate descriptions which have been given of this interesting worm by the above-cited authors render any repetition of them here unnecessary.

I found this species in flower-pots and in garden-mould at Borgfelde, near Hamburg.

Buchholzia fallax, nov. spec.,

is a slender worm, about 10 millim. in length, of a white colour with a slight brownish tinge. The setæ (fig. 4 *a*) are strongly sigmoidally curved, and there are usually four or five, rarely six, in each tuft. The setæ of the same bundle are of different length, and so arranged that a ventral bundle and the corresponding superjacent lateral one turn the longer setæ towards each other. Head-pore as above described.

Lymph-corpuscles as shown in fig. 4 *b*. The salivary glands are still more reduced than those of *B. appendiculata*, stumpy, about six times as long as broad. The intestinal diverticulum (fig. 4 *c*) differs only in unimportant points from that of *B. appendiculata* (see 9, pp. 299, 300, figs. 7–9). I describe it below. The very narrow œsophagus at its passage into the wide stomachal part is somewhat invaginated in the latter, so that dorsally a broad pouch of no great depth is produced. From the bottom of this pouch proceed thin, sparingly branched, cæcal tubes (I believe I have seen more than two of them), which are brought together into a rounded convolution. The thickness of the tubes is not so uniform as in *B. appendiculata*, nor are they so closely squeezed together as in that worm. The membrane of the intestinal blood-sinus passes on to the intestinal diverticulum, surrounds it, and is continued forward directly into the wall of the dorsal vessel. In *B. fallax* the intestinal diverticulum is firmly attached to the œsophagus, and even half embraces it. A median longitudinal constriction, such as occurs in *B. appendiculata*, is entirely deficient. The cerebrum of our worm is emarginate before and behind, much longer than broad, with the lateral margins anteriorly convergent (fig. 4 *d*). The segmental organs consist of a small stumpy anteseptale and a flat, irregularly oval postseptale, with a rather short efferent duct.

The sexual organs show the arrangement normal in the Enchytræidæ. The seminal funnels are irregularly cylindrical, excentrically perforated, about three times as long as broad, with a widely everted margin. The seminal canals are long, and regularly packed together, very much in the way that ships' cables are laid together. The oviducts are like those of other Enchytræidæ. The seminal pouches are very elegant (fig. 4 *e*). The efferent duct is simple, rather long, with two pyriform glands at the orifice. The main portion is reversed-pyriform (with the broad pole turned towards the aperture), and communicates at the apex with the intestine. By depression and subsequent overgrowth there is produced in the wall of the main portion an annular canal, which is connected with the actual lumen of the part only by narrow fissures. This canal is destined for the reception of the semen; it is homologous with the side-pouches of the seminal sacs of *Enchytræus hegemon* and other Enchytræidæ. I have never found semen in the actual lumen of the main portion.

I will further mention that in one animal I found a connecting duct between two consecutive segmental organs, an abnormity such as Vejdovsky describes (8) in an *Anachæta*

bohemica. The anteseptale of the second segmental organ was much elongated, and passed anteriorly into the postseptale of the first one. The canal traversing the uniting piece showed active vibration. I will also describe another abnormity of pretty frequent occurrence. In some animals I found in segment VI., in another in VII. and VIII., and in others again in IX., in the ventral median line, verruciform hypodermal growths, which, both in optical longitudinal section and in transverse sections, had exactly the aspect of imperforate penes; even a central pit-like depression of the cuticle was recognizable. Their not being paired, indeed, was opposed to the notion that these growths were rudimentary penes; but if it should be proved that this supposition was nevertheless justified, there would be an interesting relation between the abnormal position of the sexual organs in *B. appendiculata* and these at present enigmatic organs.

B. fallax lives in rich, well-manured soil at Steinwärder, near Hamburg.

Classification of the Enchytræidæ.

A. Setæ sigmoidally curved.
  * Head-pore large, at the apex of the head-lobe or near it. Salivary glands not present. Blood colourless; dorsal vessel with a cardiac body. Seminal ducts short, not more than eight times the length of the seminal funnel ..... Genus *Mesenchytræus*, Eisen.
  † Head-pore small, between the cephalic ring and the head-lobe. Seminal ducts long.
    a. No salivary glands. Blood yellow or red. Dorsal vessel with no cardiac body..... Genus *Pachydrilus*, Clap.
    b. Short salivary glands opening into the œsophagus. The dorsal vessel originates upon an intestinal diverticulum in segment VII. Genus *Buchholzia*, Mich.

B. Setæ straight, with only a slight curvature at the inner extremity.
  Head-pore small, between the cephalic ring and the head-lobe. Blood colourless. Dorsal vessel with no cardiac body. Salivary glands usually strongly developed. Seminal ducts long. Genus *Enchytræus*, Henle.

C. Setæ aborted.
  Head-pore large, at the apex of the head-lobe. Blood colourless. Dorsal vessel without cardiac body. An unpaired salivary gland lies on the intestine. Seminal ducts long, more or less regularly contorted, like a screw. Seminal sacs large, projecting freely into the body-cavity, not united with the intestine. Genus *Anachæta*, Vejd.

I may be allowed to add to this systematic summary a few words of explanation. This combination of the two published systems was derived directly from the results of the preceding discussions. It differs very considerably from Vejdovsky's (8) former combination. Vejdovsky places the genus *Pachy-*

drilus side by side with the genus *Enchytræus*, and then divides the latter, in accordance with Eisen's principle of division, into the three subgenera *Mesenchytræus*, *Archienchytræus*, and *Neoenchytræus*. (He, however, retains for the different species the name of the principal genus *Enchytræus*.) Against this combination we have the circumstance that the true *Mesenchytræi* (at that time only Eisen's three species), as being Enchytræidæ without salivary glands, and with sigmoidally curved setæ, cannot be arranged under the genus *Enchytræus*; they come much nearer to the *Pachydrili*. As, further, the fourth species which Vejdovsky has placed in this subgenus, namely *Enchytræus* (*Buchholzia*, aut.) *appendiculatus*, Buchh., in my opinion is to be separated from the genus *Enchytræus*, Vejdovsky's subgenus of the species of *Enchytræus* with the cerebrum straightly truncated behind must altogether fall. I might, certainly, have divided the genus *Enchytræus* of my system into the subgenera *Archienchytræus* and *Neoenchytræus*, but I do not think that this would have produced a natural grouping. The genus *Enchytræus* for the present remains a collective genus. I have not yet thoroughly worked through the species of this genus, and I am therefore still without the insight necessary to enable me at present to state by what principles of division their breaking up into natural groups may best be effected. I believe, however, that by the changes which I have made in the classification, I have made a step in the right direction, on the road which will lead us to a satisfactory, natural classification of the interesting family of the Enchytræidæ.

EXPLANATION OF PLATE XVIII.

Fig. 1. *Mesenchytræus Beumeri*, aut. *a.* Bundle of setæ. *b.* Lymph-corpuscles. *c.* Cerebrum, seen from above; *c*, commissure; *k.n*, cephalic nerve; *om*, upper, *um*, lower pair of cerebral muscles. *d.* Segmental organ. *e.* Transverse section of the dorsal vessel with the cardiac body. *f.* Seminal sac.

Fig. 2. *Mesenchytræus flavidus*, aut. *a.* Seminal sac. *b.* Cerebrum (references as in fig. 1*c*). *c.* Segmental organ. *d.* Seminal duct.

Fig. 3. *Mesenchytræus mirabilis*, Eisen. *a.* Tangential section through a lobe of the segmental organ. *b.* Transverse section through the dorsal vessel, with the cardiac body.

Fig. 4. *Buchholzia fallax*, aut. *a.* Bundle of setæ. *b.* Lymph-corpuscles. *c.* Transverse section through the œsophagus, with the diverticulum (corresponding to the author's figure (9), fig. 8). *d.* Cerebrum (references as in fig. 1*c*). *e.* Seminal sac.

LXII.—*Mr. Dendy on the* Chalininæ.

By R. von Lendenfeld.

My friend Mr. A. Dendy has recently published a paper entitled "The New System of Chalininæ, with some Brief Observations upon Zoological Nomenclature" (Ann. & Mag. Nat. Hist. November 1887, p. 326). Every reader of it will probably have been as surprised as I was to find that this paper is simply a review of an account of the Australian Chalininæ recently published by me ('Zoologische Jahrbücher,' vol. ii. 1887), as my name does not occur in the title.

Mr. Dendy draws attention to some mistakes in my paper, for which I am much obliged, as his review will in this way partly serve as a list of errata to my original essay, and thus add to its utility. I hope that he has pretty well exhausted the mistakes contained in it, as it produces the impression that he looked for them with much trouble and as logomachy is evidently not among Mr. Dendy's faults.

A number of his statements, although made in a very confident, dogmatic style, are highly controversial, and I should be glad to make a few remarks upon these parts of Mr. Dendy's review.

Concerning the canal-system Mr. Dendy raises a doubt as to the correctness of my drawing, because I do not describe in the text every detail contained in the drawing. These details are not essential, and I omitted to describe them (1) because they are by no means common to all Chalinids, and (2) because they are in the drawing. I hope he will reexamine the type to which the drawing relates, which is under his care at the British Museum, to settle this doubt of his.

As to the apparent inconsistency involved in placing the Gelliodinæ and Ridley's *Toxochalina* in the Chalininæ, and therefore in the family Homorrhaphidæ, I can only say that such inconsistencies are unavoidable and are met with also in the families Heterorrhaphidæ and Desmacidonidæ as established—and, I think, with good reason, for it would be a mistake to attach too much importance to the shape of the spicules—by Ridley and Dendy (Report on the 'Challenger' Monaxonida). The Heterorrhaphidæ are characterized as possessing differentiated microsclera, and yet Ridley and Dendy have (*l. c.* p. 32) placed *Rhizochalina* in that family, although there are no differentiated microsclera in this genus. The Desmacidonidæ are characterized by the possession of chelæ, and yet Ridley and Dendy place sponges in this family which

have no chelæ. In their Report the following are described as forms of Desmacidonidæ without chelæ: *Echinoclathria glabra*, *Agelas*, and *Echinodictyum*. As the authors no doubt knew very well, there are a number of such besides those three contained in the 'Challenger' collection. No doubt these are true Desmacidonidæ.

To make these important exceptions appear less conspicuous Ridley and Dendy say (*l. c.* p. 62) in a little footnote—nothing is said about any exceptions in the diagnosis of the genus—that they have "included *one or two* species without chelæ, on the supposition that they have had them, and subsequently lost them," in the family Desmacidonidæ. This method of shelving *one species and two genera* described, besides many more not in the 'Challenger' collection, which appear inconvenient to a preconceived idea as "one or two" species, "gives us," to use Mr. Dendy's own words (p. 336), "some insight into his method of working."

The inconsistency is in all cases apparent, but it is no fault of the authors. The method of arranging organisms in families, genera, species, &c. is, as carried out by us, unnatural, and the faults which result from it must be ascribed to the method employed, and not to the biologists who use it.

I do not see why the Homorrhaphidæ should not comprise sponges *with* differentiated microsclera, as the other two families comprise forms *without* them. The arrangement is, in consequence of this want of precision, open to objection; but it was not I who established it, but Ridley and Dendy. The precision of the other families would not be increased if the sponges referred to were removed from this family.

It is all very well to say that the amount of spongin has only very little systematic significance, and that this has been "demonstrated again and again." I also agree with Mr. Dendy that the amount of spongin has no great significance; but it must be borne in mind that F. E. Schulze ('Challenger' Report on the Hexactinellida, p. 497) attaches a good deal of importance to it; and Schulze probably knows more about sponges, and certainly has a much more matured judgment, than my friend Mr. Dendy and myself put together. It gives me the impression that Mr. Dendy has allowed himself to be carried away by his own strong convictions, and he inveighs against my arrangement—which, like all similar arrangements, is a subjective idea, and doubtless faulty and bad—with a force worthy of a better cause.

Mr. Dendy attacks my method of nomenclature most unmercifully. He persistently closes his eyes, however, to the logical principle which I maintain in it, and thinks it

sufficient to show that my nomenclature is, according to the method to which he has accustomed himself, untenable and peculiar. This is certainly the case; but it could equally well be shown that the method employed by Mr. Dendy is illogical, unreasonable, and bad. I do not find that the logical correctness of my system is questioned, but Mr. Dendy takes it upon himself to say that it cannot be right. The principles on which I name the species &c. are very different from the method employed by him; and to enable the reader to form a judgment on the method of nomenclature employed by me, I give an abstract of it here.

If a species is described and I redescribe it without altering its limits and definition, and without placing it in another genus, I attach to it the author's name, because I retain his species.

If a species is retained by me in its original scope, but placed in another genus, I retain the specific name and replace the name of the original author by my own, because the name under which I describe it is different from that used by the original author. F. E. Schulze ('Challenger' Report on the Hexactinellida) gives in such cases the name of the original author in brackets, and sometimes adds another, as, for instance, in the case of *Farrea occa* (Bowerbank), Carter (p. 277).

If I retain a previously described species but alter its scope, I retain the old name, unless it is objectionable, and affix my name to it, because it is in this sense a *new* species.

If a species has been described under various specific names I take the oldest of those which apply to the species *in my sense*, and not to the oldest of all irrespective of this.

If I combine a number of *different* sponges previously described to form one species, I give it a new name, because none of the previous names applies to the species *in my sense*, which is *new*.

If sponges belonging to different species have been described as one and the same species (this does not occur often), I of course establish new species for the parts thereof.

If I raise varieties to the rank of species, I retain the name of the variety if suitable and attach my name to it, because as a species it is new.

If I distribute a number of sponges previously described among varieties of one species, I of course give these as synonyms of the varieties, and establish a new name for the species, under which the old names do not appear as synonyms.

I hold strong opinions on this point, and am radically

averse to the certainly illogical, although perhaps easy, way of naming things in vogue among many naturalists, including Mr. Dendy. I do, however, by no means imagine that I have established this rational system of nomenclature, as I will call it. It was established long ago, and has been most carefully utilized for practical work by Häckel in his 'System der Medusen.' I do not think that any difference at all exists between Häckel's method and mine, and I am further not aware that I have made any mistakes in the nomenclature either in my paper on the Chalinids or elsewhere.

It seems to me as if Mr. Dendy wished to veil his real attack on the principle involved by the feigned polemic against my Chalinid nomenclature. Well, I suppose everything is fair in love and in war! But somehow I do not like this perversion of the real issue.

To show the fallacies of the system of nomenclature advocated and employed by Mr. Dendy one need only look in the Report on the 'Challenger' Monaxonida by Ridley and Dendy. The volume opens at page 117. There a species is described as *Iophon Pattersoni*, Bowerbank. On the following page a variety "*Pattersoni*" is mentioned. A comparison of Bowerbank's original diagnosis shows that *his* species *Halichondria Pattersoni* is nearly identical with the *variety Pattersoni*. The species *Iophon Pattersoni* as established by Ridley and Dendy differs entirely from Bowerbank's sponge, and it is simply *untrue* that the species described by Ridley and Dendy as *Iophon Pattersoni* is synonymous with *Halichondria Pattersoni*, or was ever established or conceived by Bowerbank. The species has been established by Ridley and Dendy, and their names should be attached to the specific name. *Halichondria Pattersoni*, Bowerbank, should be given as a synonym of the variety, *Iophon Pattersoni*, var. *Pattersoni* (sic!).

As none of the previously described species coincide with the *Iophon Pattersoni* of Ridley and Dendy, a *new* specific name ought to have been given. Any one of the old names would give a wrong idea, and it would be illogical to use it, as it is obviously illogical to replace the whole by a part.

Such tamperings with the laws of thought have already brought our science into the contempt of mathematicians and philosophers. Logic must be sternly established. I regret that my friend Mr. Dendy and I hold such diametrically opposite views; and I can only answer to his statement (p. 337) "Whatever may be the real name of this comprehensive species, it certainly cannot be '*Ceraochalina papil-*

lata, n. sp.!' " that this name is perfectly logical and must be upheld; and, further, concerning Ridley and Dendy's *Iophon Pattersoni*, that whatever may be the real name of this comprehensive species, it certainly cannot be "*Iophon Pattersoni*, Bowerbank"!

Mr. Dendy cites the name of another of my species, and criticizes it as "beyond comment." I regret that my mental faculties are so feeble that I cannot see even the slightest objection to it!

Mr. Dendy enters a protest against the "free-and-easy system of nomenclature" used by me. It is not necessary to waste any words on such a phrase; but I must enter a protest against the cramped and illogical, although easier, method employed by Mr. Dendy.

I have been able to meet all Mr. Dendy's objections in the same objective and friendly manner in which no doubt they were meant, however forcible Mr. Dendy's language may be.

There is, however, one assertion which I am sorry to say cannot be viewed in this light. Mr. Dendy says (p. 336) that by my method I was "as it were capturing all stray species and taking forcible possession of them." Trusting that Mr. Dendy will regret the wording of that passage, I feel that it is incumbent on me to express my thanks to him for exposing the mistakes contained in my paper, and for showing me on what points a clearer expression of my views was desirable.

LXIII.—*Descriptions of six new Species of Butterflies captured by Mr. John Whitehead at Kina Balu Mountain, North Borneo, in the Collection of Mr. H. Grose Smith.* By H. Grose Smith.

Papilio acheron.

Male.—Upperside. Both wings bluish black, slightly suffused with purple; margins between the nervures narrowly white; the posterior wings slightly irrorated with grey in the anal area.

Underside. Both wings with markings as in my *P. Forbesi*, except that the grey rays between the nervules on the anterior wings are less marked, the ochraceous band on the posterior wings does not extend beyond the upper median nervule, and the three blue spots near the exterior margin between the costal nervure and the discoidal nervule are less

distinct; the white spots on the margins between the nervules are much narrower.

Expanse of wings 4 inches.

Nearest to *P. Forbesi.*

Papilio stratiotes.

Male.—Upperside. White, tinged at the base with pale greenish yellow. Anterior wings with the costal margin and cell crossed by four black fasciæ; the basal fascia narrow, the second, third, and fourth wedge-shaped, the fourth extending beyond the discocellular nervules; beyond the fourth fascia is a semitransparent space divided by the discoidal nervules, which are black; apex broadly black, centred with another transparent space, divided by the black nervules. Posterior wings with exterior margins narrowly black and three black lunate spots near the anal angle; anal area grey, a large bright, quadrangular, carminé spot at the anal angle, bordered on the upperside with black and on the inside on the inner margin with a white linear spot. Tails narrow and black, with white margins.

Underside. Anterior wings as above, tinged at the base with yellowish brown. Posterior wings ochraceous, crossed at the middle and near the base by two black bands, slightly convergent towards the anal angle and extending as far as the greyish-black space above the anal carmine spot; the exterior margin and anal area broadly black, irrorated towards the anal angle with grey, the carmine spot as above, the discocellular and median nervules black; two small black spots below the former.

Expanse of wings $3\frac{3}{4}$ inches.

This insect appears to be intermediate between *P. antiphates*, Cramer, and *P. agetes*, Westwood; in shape and markings of the upperside it approaches *P. agetes*, on the underside it bears a superficial resemblance to *P. antiphates.*

Papilio procles.

Near to *P. bathycles*, Zink., but differs from it in the following respects:—Anterior wings: upperside, four spots only in the cell, the second and third being almost obsolete; the three lowest spots of the discal row of spots confluent and broader than in *P. bathycles.* On the posterior wings the three discal spots are larger and confluent, instead of being distinct, and the wings are more deeply emarginate. On the underside of posterior wings the large silvery patch is not traversed near

the centre by a concave brown fascia, as in *P. bathycles*, but in lieu of it there is a short, narrow, brown fascia from the costa nearly as far as the subcostal nervure, almost divided on the costal nervure by a small orange-red spot, and there is a small triangular silvery spot next the cell between the upper and second discocellular nervules. The dark brown area in which the series of orange-red spots towards the anal angle is situated is broader than in *P. bathycles*, and the submarginal row of spots is further from the margin.

Expanse of wings 2½ inches.

Papilio macaristus.

Near to *P. macareus*, Godart, but differs from it in the following respects:—Anterior wings: upperside, in place of the double row of three spots and three short bars in the space between the end of the cell and the upper part of the submarginal row of spots, there are three elongated streaks, slightly clavate at the ends nearest the cell. On the posterior wings the streaks in the area between the cell and the exterior margin are very short and narrow. Underneath, all the streaks on the posterior wings are very indistinct, some being almost obsolete, while in *P. macareus* they are quite as large and distinct as on the upperside; the body is black, with a narrow grey stripe on each side. Two specimens of *P. macareus* in my collection from Sumatra have bright brown bodies, and two others from Darjeeling have black bodies broadly striped with grey.

I should have been disposed to look upon this insect as a variety only of *P. macareus* if there had not been in the collection a uniform series of it from the same locality.

Expanse of wings 3½ inches.

Appias Whiteheadi.

Male. Above, approximates to *A. pandione*, Hübn., but on the anterior wings the apical area is more extensively black, and in place of the large subquadrate black spot at the end of the cell of *A. pandione*, which is contiguous with the greyish-black costal area, there is a small black spot quite distinct. The second submarginal white spot in the middle of the apical area is almost obsolete. On the posterior wings the black margin is double the width of that of *A. pandione*, extending over the exterior third of the wings. Below, it differs from *A. pandione* on the anterior wings in the spot at the end of the cell being very small and distinct, and the apex being pinkish grey. On the posterior wings the basal third is light

ochraceous, very slightly irrorated with grey towards the base; the remainder of the wings pinkish grey, crossed with an indistinct irregular dark band, bordered externally towards the apex with pale pinkish grey; the spot at the end of the cell is bright ochraceous.

Expanse of wings $2\frac{5}{8}$ inches.

Ragadia annulata.

Upperside. Both wings stramineous, with the band, costal margin of anterior wings, and exterior margin of both wings broadly ashy brown, crossed near the apex as far as the first median nervule by an ashy-brown bar; beyond that nervule the bar is discontinued on the upperside, but it shows through from the underside, where it is prolonged across both wings to the inner margin.

Underside. Anterior wings crossed by three ashy-brown bands, the submarginal band having eight ocelli; costal and outer margins ashy brown. Posterior wings with three bands, the middle band concave and the outer one with six ocelli, the second, third, and fourth being the largest. All the ocelli are black, with silver pupils, the iris ochraceous, the second and third on the posterior wing enclosed in one iris.

Expanse of wings $1\frac{1}{2}$ inch.

LXIV.—*On the Development of the Sexual Products in* Spongilla. By Karl Fiedler *.

Since Lieberkühn † in 1856 discovered both spermatozoa and ova in *Spongilla*, and thus for the first time demonstrated the presence of these important structures in the sponges, the history of their production has been treated of in a long series of spongological memoirs. The further development of the freshwater sponge has also been of late years repeatedly made the subject of investigation. The results

* Translated from a separate copy from the 'Zoologischer Anzeiger,' no. 266, 1887, communicated by the Author.

† N. Lieberkühn, "Beiträge zur Entwicklungsgeschichte der Spongillen," in Müller's Archiv für Anat. und Physiol. 1856, p. 17, and also "Zusätze zur Entwicklungsgeschichte der Spongillen," *ibid.* p. 501.

obtained by the two most recent observers, Ganin * and Gœtte†, however, do not agree in many points.

Therefore, as my honoured master Prof. F. E. Schulze recommended me to make a fresh investigation, I entered upon it willingly, in the hope, if possible, of contributing something to the clearing up of the affair. The chief part of the work was executed during the summer term of the present year in the Zoological Institute of the University of Berlin, and I would in this place express my most sincere thanks to Prof. Schulze for his assistance therein. As material I had at my disposal *Spongilla fluviatilis*, which abounds in the Spree. A detailed statement of my results I hope to be able to publish shortly; here I shall only briefly indicate what relates to the formation of the ovum and semen.

In the first place, in opposition to Gœtte's notion I must maintain the unicellularity of the ovum of *Spongilla*. Gœtte's own figures furnish no absolute proof of his view, according to which from the primordial ovum there proceed several cells, one of which grows to a large size, while of the others some take part in the formation of the follicle, and the rest become amalgamated again with the large cell. Thus "only is the foundation of the ovum completed." In the ovicell I have always found distinct cell-limits, and, what appears to be conclusive, only a single nucleus. I lay the more stress upon the latter circumstance, because I have succeeded, by double-staining, in clearly distinguishing the nuclear and vitelline formations. In single-stainings a confusion in this respect is almost inevitable, and Gœtte may in this way have been led astray. The method of double-staining with picro-carmine and bleu de Lyon, introduced by Maurice and Schulgin ‡ and recently advocated by Blochmann §, gives, after a short washing of the sections with a little ammoniacal alcohol, a fine red coloration of the nuclei and a brilliant blue coloration of even the smallest particles of the vitellus.

Thus also it appeared that in the ovum the large round vitelline globules do not, as Gœtte thinks, make their appear-

* M. Ganin, "Zur Entwicklung der *Spongilla fluviatilis*," in Zool. Anz. i. 1878, pp. 195–199, and 'Beiträge zur Kenntniss des Baues und der Entwicklung der Schwämme' (in Russian), Warsaw.

† A. Gœtte, "Untersuchungen zur Entwicklungsgeschichte von *Spongilla fluviatilis*," in 'Abhandl. zur Entwicklungsgeschichte der Thiere,' Heft 3 (Hamburg and Leipzig, 1886).

‡ Maurice and Schulgin, "Embryogénie de l'*Amouroucium proliferum*," in Ann. Sci. Nat. Zool. sér. 6, tome xvii. p. 6 (1884).

§ F. Blochmann, "Ueber die Reifung der Eier bei Ameisen und Wespen," Festschr. zur Feier des 500 jähr. Bestehens d. Ruperto-Carola, issued by the Naturh. Ver. zu Heidelberg, 1886, p. 118.

ance at first, but that they are preceded by all possible stages of smaller vitelline elements. A regular arrangement, such as that the vitelline globules increase in size from the periphery to the centre, is not, however, to be observed.

The follicle-cells I regard simply as parenchyma-cells pressed against each other by the pressure of the growing ovum, and so flattened against each other. Some of them I would characterize as specific nutritive cells, taking this notion more in the sense adopted by F. E. Schulze, Keller, &c., than by Gœtte. Thus in preparation with Flemming's chrom-osmium-acetic acid mixture, besides the vitelline granules of the ovum, many of the cells surrounding the ovum undergo an intense blackening of their contents. The number of cells of this kind which also occur isolated in the rest of the sponge-body constantly increases up to a certain time exactly in the neighbourhood of the ovicells. Frequently they penetrate with their amœboid processes between the ordinary follicle-cells and towards the ovum itself, but without uniting with the latter. They do not contain ready-made vitellus, as the above-mentioned blue staining material does not produce in them the same reaction as in the ovum. On the other hand, they prepare in their bodies a material which is to be regarded as a fore-stage of the vitellus, and which is given off to the ovum by the process of diffusion. Even after the first segmentations we notice a distinct diminution in the number of such blackened cells, and the ordinary follicle-cells also become fainter, if I may so express myself. Finally, the products of segmentation are surrounded only by a very delicate follicular membrane, which certainly has no longer any actively nutritive function. But even if, at first, several cells contribute to the nourishment of the ovum, the latter, as Korschelt* aptly remarks in a similar case, "does not, by the inception of secretion-products of other cells, lose its own cell-nature any more than an *Amœba* loses its unicellularity by the inception of food. The characteristic is the living capacity of assimilation of both towards the nutritive material offered to them."

We have to distinguish from the nutritive cells above described certain amœboid wandering cells of another kind, the bodies of which are filled, not with irregular granulations, but quite uniformly with particles of considerable size; only occasionally a perfectly hyaline marginal zone occurs. These

* E. Korschelt, "Ueber die Entstehung und Bedeutung der verschiedenen Zellenelemente des Insectenovariums," in Zeitschr. für wiss. Zool. Bd. xliii. p. 690 (1886).

correspond to the cells described by Poléjaeff* in his 'Challenger' Calcarea, to which he ascribes "nutritive functions," and, indeed, in the sense of "reception of nourishment." In *Spongilla* they were first observed by Weltner (of Berlin) and subsequently, but independently, by myself. They are also diffused through the whole sponge-body, but are particularly abundant beneath and even between the cells of the cuticle, and here again often in the vicinity of the inhalant apertures. Their regularly granulated plasma then contains further more intensely coloured particles of irregular form. If the latter, as seems most probable, are incepted nutritive constituents, this would be in agreement with the above-cited notion of Poléjaeff, and would also explain von Lendenfeld's† statements with regard to the inception of nourishment through the external surface of the sponges, without the ectodermal cells needing to take part in the operation. As Weltner proposes to make further communications upon the peculiarities of these cells, I shall confine myself to these indications. Only I may say further that the ovicells are not to be referred to these uniformly granulated cells, but to the wandering cells of the ordinary kind.

The growing ovum, which, in earlier stages, sometimes shows a remarkable radiation of the plasma, now becomes gradually more and more filled with vitelline granules. The nucleus, however, never entirely disappears. But while at first it always occupies the middle of the ovum, we find it now most frequently removed close to the surface. In both cases it is surrounded by a circle of plasma comparatively poor in vitelline material. There can be no doubt that this remarkable change of position in the nucleus is connected with the elimination of the so-called direction-corpuscles. In fact I repeatedly observed in the neighbourhood of the nucleus two considerably smaller but no less vividly coloured chromatin-particles, which are probably to be characterized as the abconstricted direction-corpuscles. Thus this important process, recently interpreted with so much genius by Weismann ‡, is rendered probable even for the lowest group of the Metazoa. Unfortunately I did not succeed in tracing, on the one hand the formation of the direction spindles, or on the other the process of fertilization. It is clear, however, that the nucleus

* N. Poléjaeff, "Report on the Calcarea dredged by H.M.S. 'Challenger,'" in Report, vol. viii. p. 6 (1883).

† R. von Lendenfeld, "Neue Cœlenteraten der Südsee, II. Neue Aplysinidæ," in Zeitschr. für wiss. Zool. Bd. xxxvii. p. 234 (1883).

‡ A. Weismann, "Ueber die Zahl der Richtungskörper und über ihre Bedeutung für die Vererbung," Jena, 1887.

of the mature ovum is smaller and poorer in chromatin than that of the immature ovum. Even in the former, however, it never becomes "a perfectly homogeneous vesicle" (Gœtte); it always contains a distinct nucleolus, in a nuclear space which is certainly large and clear.

Similar nuclei may be detected by means of double-staining in all segmentation-spheres. Even in rather thick sections of the younger stages they shine out red from the blue vitelline masses. In older stages they are the more easily visible, because they are surrounded only by a single layer of vitelline globules. Finally, not only the number but also the size of the vitelline elements diminishes still more by disintegration. But I must decidedly deny any new formation of nuclei by direct transformation of vitelline globules. The cell-nuclei of the young *Spongilla* are rather derived in uninterrupted sequence from the nucleus of the fecundated ovum, and here also, as Ganin indeed conjectured, the principle applies:—"Omnis nucleus e nucleo."

Although, in the course of the process of segmentation, I was unable to observe any karyokinetic figures (no doubt in consequence of the quantity of vitellus in the ova), they forced themselves upon me in the greatest abundance and multiplicity during the spermatogenesis. The extraordinary minuteness of the object certainly added considerably to the difficulty of the investigation; nevertheless, besides the commonest coil-form, representatives of the star-, spindle-, and barrel-forms could be recognized. Without going further into details, I may remark that the sperm-formation takes place in accordance with the second type established by Poléjaeff* for the sponges. I can therefore confirm the short statement made by F. E. Schulze† in his classical "Investigations upon the Structure and Development of the Sponges," according to which *Spongilla* approaches *Halisarca* as regards these peculiarities. There is therefore no formation of a special covering-cell or of a primordial seminal cell. On the contrary, a cell distinguished by its particularly large, strongly colourable nucleus, being converted into the sperm-mother-cell, divides repeatedly and, indeed, always with formation of filaments, while surrounding parenchyma-cells close together to form a follicle, as in the case of the ovum. The follicle is, how-

* N. Poléjaeff, "Ueber das Sperma und die Spermatogenese bei *Sycandra raphanus*," in Sitzb. der Akad. Wiss. in Wien, Bd. lxxxvi. p. 276 (1882).

† F. E. Schulze, "Untersuchungen über den Bau und die Entwicklung der Spongien, II. Die Gattung *Halisarca*," in Zeitschr. für wiss. Zool. Bd. xxxviii. (1877).

ever, not so strongly made as in the latter, and if its cells furnish nutritive material to the sperm-cells, their importance is probably only that of an intermediate station. After the last division the coil form of the nucleus passes into a perfectly dense chromatin-globule. This becomes the head of the spermatozoon, and the scanty clear protoplasm which surrounds it is drawn out into the filament. Sometimes within the same follicle the development of the spermatozoa goes on at different rates, so that, for example, one half of it appears filled with mature spermatozoa, the tails of which are all directed towards the centre, while the other half still shows different stages of division.

The development of the ova, as of the spermatozoa of *Spongilla*, consequently approaches in a most satisfactory manner to the processes repeatedly observed in higher animals, although many peculiarities cannot be denied.

LXV.—*Diagnoses of two new Central-African Mammalia.*

By Oldfield Thomas.

The two following new species occur in the collection recently sent to the Natural-History Museum by Emin Pasha.

Dendrohyrax Emini, sp. n.

Allied to and of about the size of *D. arboreus*, Sm., but, instead of greyish brown, uniformly pale yellowish white all over above and below, very much the colour of the centre of the belly of *D. arboreus*.

Hab. Tingasi, Monbuttu, Central Africa.

Anomalurus pusillus, sp. n.

Allied to and coloured above like *A. Beecrofti*, Fraser, but differing markedly by its much smaller size (hind foot 42 millim., molar series 9·5 millim. long) and by its greyish-white instead of rufous underside.

Hab. Bellima and Tingasi, Monbuttu.

PROCEEDINGS OF LEARNED SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, May 13, 1887.—Henry Pollock, Esq., Treasurer and Vice-President, in the Chair.

Some Electrical Fishes. By Professor J. S. Burdon Sanderson, M.D., LL.D., F.R.S.

The lecture was divided into three parts, in the first of which a general description was given of the three most important electrical fish, viz. the torpedo, or electrical ray, the electrical eel of the rivers and lakes of South America, and the *Malapterurus* of the Nile and Senegal. In the second part the lecturer discussed the anatomical character and morphological significance of the electrical organ in the torpedo, and in the third its mode of action, with special reference to the recent investigations of Mr. Francis Gotch, Assistant in the Physiological Department at Oxford. The description given of the structure of the organ was also founded on new investigations by Prof. Ewart, of Edinburgh, who had been good enough to prepare drawings on glass, suitable for projection on the screen, of his microscopical preparations. The first of these drawings showed a section of the already active electrical organ of a torpedo just born. It was seen to consist of a great number of tubular columns which extended from the upper (dorsal) to the lower (ventral) surface of the flattened body of the animal, which were as closely packed together as the cells of a honeycomb, each column being divided into very narrow compartments by nearly horizontal partitions of extremely fine membrane. It was next pointed out that, although the whole organ is made up in the common torpedo of as many as 500 such columns (in some species many more), each column is in structure and in function an electrical organ of itself; and not only so, but that each of the fine membranous partitions or *plates* is an electromotive structure of which, notwithstanding its almost inconceivable tenuity, the two opposite surfaces are, when in activity, in different electrical states; so that, in consequence of their pile-like arrangement and their all acting in the same direction, the electromotive force excited by the whole column is, as in a voltaic battery, equal to the *sum* of the forces exerted by the many hundreds of plates of which it is composed.

It having thus been made evident that everything depended on the plates, the lecturer proceeded to explain their minute structure, for the investigation of which it was of course necessary to employ much higher powers. The microscopical drawings which were thrown on the screen showed that each of the fine membranes which had been described consists of two different structures. Its upper surface presents a layer of apparently homogeneous material in which

nuclei are distributed at intervals. This may be called the protoplasmic lamina. The under or ventral layer might be called the nerve-lamina, for it is made up of the arborizations of the innumerable nervous filaments which spread themselves over the protoplasmic lamina on its under surface. As these filaments branch repeatedly as they approach their destination, their ultimate endings are among the smallest objects which can be distinguished under the microscope.

The electrical organ offers to the physiologist one of the most striking examples of that adaptation of structure to function which is universal among living beings. A single column of the organ of the torpedo resembles in a very remarkable degree a voltaic pile, of which the plates are the elements, but it is a resemblance with a difference. The difference lies in this, that the organ is only a battery when it is waked into activity by a stimulus. This waking up or (to use the ordinary language of physiology) excitation is derived from the animal's brain, which for the purpose has added to it a special electric lobe on each side, from which the enormous nerves, which are so richly supplied to the electrical organ, emanate. The use of this lobe is obviously not to produce electricity itself, but, at the will of the animal, to set free the energy of the organ, *i. e.* of each of the many thousand plates of which it consists. Thus, of the two laminæ of each plate, the nervous and the protoplasmic, each represents a distinct function—the protoplasmic that of producing the required electromotive effect, the nervous that of receiving from the brain and communicating to the protoplasm the impulse by which it is discharged.

In a former lecture it had been shown that all the ordinary physiological changes which occur at every moment of our existence in what Bichat called the organs of animal life, particularly in our nerves and muscles, are accompanied by electrical changes, and that although it is not yet possible to give any physical explanation of these changes, rapid progress is now being made in determining the laws of their association with the other physical concomitants of muscular and nervous action. As it is practically much more important to understand the physiology of muscle and nerve than that of the electrical organs of a few fish, the latter has been comparatively insufficiently studied. The purpose of the experiments made at Arcachon is to bring the phenomena of the electrical discharge or shock of the torpedo and the physiology of its organ into line with the already very accurately investigated phenomena of nerve and muscle. With reference to these last, certain very definite laws have been established, of which, perhaps, the most fundamental is that, when functionally at rest, these structures exhibit no electromotive action. The structure must have been *previously* acted upon by some external agency capable of exciting it. Another established fact is that the effect is of limited duration, and that for its development a certain time must elapse, which under similar conditions is always the same for the same structure. A third is

that all kinds of excitants act in the same way, the effects differing in intensity, not in direction. In all these respects, and in others of less importance, the electrical plate agrees with muscle and nerve. Inasmuch, therefore, as we have met with a structure of which the development of electrical action is the exclusive function, there seems to be good reason for the hope that by its investigation a nearer approach may be made than has hitherto been possible to the central question—that of the reason why in all animal structures the transition from the inactive to the active state is, so far as our present knowledge teaches, always accompanied by electrical change.

The question why certain fish are endowed with so singular a means of offence and defence, which others allied to them zoologically do not possess, and, above all, why some fish have electrical organs so small as to be useless, is as difficult to answer now as when Mr. Darwin wrote the 'Origin of Species.' The facts relating to the development of the organ, which teach us to regard it as, in some sense, a modified muscle, might suggest that the transition from muscle to organ was a gradual one, determined by external conditions. But we are prevented from accepting any such suggestion by the consideration that an electrical organ only becomes advantageous to its possessor when it has acquired sufficient size to be used in the capture of prey, and that in all previous stages of transition it must be useless. Natural selection could not therefore determine the development of the electrical organ by modification of muscle. It is more reasonable to imagine that all fish, or at any rate certain families of fish, possess an undeveloped element of structure, of which the electrical organ is the manifestation. So that what we have to account for is not its presence in some exceptional cases, but its absence in the great majority.

The existence of such a tendency as this hypothesis supposes would render it possible for natural selection to operate efficiently in bringing about the observed result.

GEOLOGICAL SOCIETY.

November 9, 1887.—Prof. J. W. Judd, F.R.S., President, in the Chair.

The following communication was read:—

"Note on the so-called 'Soapstone' of Fiji." By Henry B. Brady, F.R.S.

The Suva deposit, which has a composition very similar to that of the volcanic muds at present forming around oceanic islands in the Pacific, is friable and easily disintegrated. The colour ranges from nearly white to dark grey, the mass being usually speckled

with minerals of a darker hue. Under the microscope the rock presents the character of a fine siliceous mud with crystals of augite &c., together with the sparsely scattered tests of Foraminifera. The approximate chemical composition of typical specimens is:—Silica, 50 per cent.; alumina, 18 per cent.; lime and magnesia, from 5 to 6 per cent.; ferric oxide, from 3 to 8 per cent.; water, 16 per cent., with a small proportion of alkalies, chiefly potash, and but small trace of carbonates.

The Author's attention was chiefly directed to the common grey friable rock, which may be softened in water and washed on a sieve, the residue consisting mainly of Foraminifera with a few Ostracoda. Of three specimens examined, 1 is a light-grey rock from close to the sea-level; 2, of a lighter colour, from about 100 feet elevation; 3 is nearly white and somewhat harder, and was derived from an intermediate point. So far as the Microzoa are concerned, the first two present no differences which might not be observed in dredgings from the recent sea-bottom, taken at similar depths a little distance apart. The third appears to have been deposited in somewhat deeper water. There is a marked scarcity of arenaceous Foraminifera.

Then followed notes on the rarer and more interesting species, together with a list of the 92 species of Foraminifera found. Of these, 87 are forms still living in the neighbourhood of the Pacific islands. Two of the remaining 5 are new to science, and the rest extremely rare. The Author concluded that these deposits are of Post-Tertiary age, formed at depths of from 150 to 200 fathoms in the neighbourhood of a volcanic region. The following new or little-known species were selected for illustration:—*Ellipsoidina ellipsoides*, var. *oblonga*, Seguenza; *Haplophragmium rugosum*, D'Orb.; *Ehrenbergina bicornis*, sp. nov.; *Sphæroidina ornata*, sp. nov.

MISCELLANEOUS.

Ægа crenulata, Lütken. By J. Duncan Matthews, F.R.S.E.

The capture off the Scottish coast of a Crustacean hitherto unrecorded from British waters seems of sufficient interest for publication.

The specimen was a parasitic Isopod, and was procured by Mr. Murray, Fishery Officer, Stonehaven, and by him forwarded to the scientific department of the Fishery Board for Scotland. Sent to the Rev. Dr. Norman for identification, it was described by him as a specimen of *Ægа crenulata*, Lütken, "a Greenland form not previously found in our seas."

This *Ægа* was taken in October 1886 from a large shark caught entangled on lines about 8 miles off Stonehaven. Unfortunately

the exact identity of the shark was not ascertained, but it was described as the blue shark, though possibly it may have been the Greenland shark, of which specimens are sometimes got on this coast.

The parasite was in fine condition and the only one procured. It measured 54 millim. in length and 21 millim. across the ventral surface.

Sebastes norvegicus. By J. Duncan Matthews, F.R.S.E.

Partly from the interest attaching to a somewhat uncommon fish, but more particularly in order to describe some variations from previously recorded examples, I wish to record here the capture of some specimens of *Sebastes norvegicus*. Three specimens which I examined (out of a total take of six) were caught in February of this year and forwarded to me at the Fishery Board for Scotland by Mr. Murray, Fishery Officer, Stonehaven. One of the specimens measured 378 millim. in length, 115 millim. in depth at back of operculum, and weighed 2 lbs. $1\frac{1}{4}$ oz.; a second was 350 millim. long, and weighed 1 lb. 10 oz.; the third was only 220 millim. in length. They were all of a bright crimson-red colour. The largest of the six taken (and which was not sent to the Laboratory) measured 458 millim. long. The three specimens above recorded make six specimens received by the Fishery Board within the last four years —all from the east coast of Scotland.

Mr. Murray's account of the locality where these six fish were caught is interesting, as confirming the statement of Couch, Day, &c., that they frequent deep water. He says that they were caught 16 miles off Stonehaven, where the general depth is 30 fathoms with gravel bottom. There are, however, off that coast numerous deep pits or holes, said to be from 60 to 100 fathoms in depth. The *Sebastes* were all caught with herring-bait on part of a small line, which had been hanging across one of these pits—said to be 70 fathoms deep. Eels were caught on the rocky bottom on each side of the pit, and these *Sebastes* were caught on the line suspended across.

The following note of the fin-rays, as found on these three specimens, and other three also examined by me, shows a rather striking variation from the record by Yarrell, Couch, Günther, and Day. These authorities all give 15 spines in the dorsal fin, and 7 to 9 soft rays in the anal fin, while in the six examples examined by me only one (figured as a *Serranus* in the Annual Report for 1883) has 15 dorsal spines, the others having only 12. Five of the six have only 6 soft anal rays, including a last ray which, springing close to the penultimate, looks somewhat like part of it. The variation from Günther's and Day's record of the number of vertebræ, in one examined in this respect, is also worthy of note.

Each had seven branchiostegal rays, and in other respects these specimens were identical with those previously recorded.

Yarrell	D 15+15 P 19	V 1+5 A 3+8 C 14
Couch	D 15+13 P 17	V 1+5 A 3+7 C 15
Günther	D $\frac{15}{15}$ ..	.. A $\frac{3}{8-9}$ .. Vert. 12/19
Day	D $\frac{15}{15}$ P 20	V 1/5 A $\frac{3}{8-9}$ C 13 Vert. 12/19
Specimens here referred to. From Shetland, 1883	D 15+13 P 19	V 1+5 A 3+7 C 15
From Berwick, 22 i. 85	D 12+12 P 20	V 1+5 A 3+6 C 16
From „ 19 v. 85	D 12+13 P {18 right 19 left}	V 1+5 A 3+6 C 14 Vert. 25
From Stonehaven, 14 ii. 87.	D 12+14 P 20	V 1+5 A 3+6 C 14
From „ „	D 12+13 P {19 right 18 left}	V 1+5 A 3+6 C 15
From „ „	D 12+13 P 19	V 1+5 A 3+6 C 16

The following measurements were taken (along a median longitudinal line) from the largest Stonehaven specimen :—

	millim.
Diameter of eye	30
Length from tip of premaxillæ to centre of eye	40
„ „ „ to posterior end of closed maxillæ	51
„ „ „ to root of pectoral fin	105
„ „ „ „ pelvic fin	114
„ „ „ „ 1st spine of dorsal fin	93
„ „ „ „ 1st soft ray of „	221
„ „ „ „ last „ „	281
„ „ „ „ 1st spine of anal fin	210
„ „ „ „ 1st soft ray of „	226
„ „ „ „ last „ „	257
„ „ „ „ outer caudal ray	315
„ „ „ to tip of caudal central rays	378
Depth through centre of eye	73
„ at root of first dorsal spine	110
„ „ „ anal „	98
„ (least) at root of tail	34

One of the three Stonehaven specimens had 6 spines on the preoperculum instead of the usual 5, the extra one being small, and situated close to the most ventral of the series.

On a new Genus of Phosphorescent Lumbricidæ, *and on the Type-species of that Genus,* Photodrilus phosphoreus, *Dugès.* By M. A. Giard.

The existence of the photogenic function among certain Lumbricidæ has often been pointed out; but very rarely have the parts which present this peculiarity been described in a sufficient manner, and the conditions under which the phosphorescence is produced are still imperfectly known. During the months of August and September I observed, at Wimereux, in the paths of a garden at some distance from the sea, a luminous earthworm, which appears to me to belong to a new genus of the group of "Lumbriciens postclitel-

liens" of Perrier, nearly allied to *Plutellus*, and more nearly still to *Pontodrilus*. To obtain a fairy spectacle it was sufficient, in the evening, especially when the weather was damp, to kick or scrape the gravel on the walks; a multitude of luminous specks, of a fine opalescent green, were at once lighted up. These specks were of unequal dimensions: the largest produced a light as bright as that of our glow-worms, and visible even in a room lighted by a good lamp. When one of these specks was taken and rubbed between the hands, both palms were soon rendered luminous. In the vicinity of each phosphorescent speck, or of each luminous streak, a small earthworm was found, which, more often than not, showed no injury, in spite of the rather rough treatment employed to discover it.

Photodrilus phosphoreus has a length of from 45 to 50 millimetres, with a width of 1·5 millimetre (2 millimetres in the clitellian region). It has about 110 segments. Its colour is of a rosy grey, orange at the cingulum. The skin is sufficiently transparent to allow the internal organs and an abundant vascular system to be seen. The setæ are short and bent; but, instead of being in pairs as in most of the Lumbricidæ, they are distant from one another as in the *Pontodrili*. They form, accordingly, eight nearly parallel longitudinal rows; the two lower ventral rows are very near together in the anteclitellian part, and the space which separates them scarcely exceeds the width of the nervous chain.

The cephalic lobe is rounded, and does not encroach upon the buccal segment. Between segments 8 and 9 (the seventh and eighth setigerous segments), on the lines of the lower ventral setæ, may be seen the orifices of the single pair of copulatory pouches. This is homologous with the second pair in *Pontodrilus*. The cingulum begins towards the superior third of the thirteenth segment, and occupies the fourteenth, fifteenth, sixteenth, and seventeenth segments; this last is very much shorter than the preceding ones. The fourteenth segment contains the female genital apertures on the lines of the lower ventral setæ and a little above these setæ. The male genital orifices are on the eighteenth segment. The segmental organs only exist below the fourteenth segment, and open externally at the upper limit of each segment outside the lines of the superior ventral setæ.

The digestive tube commences with an exsertile part (proboscis), which the animal evaginates and draws back alternately, rather slowly, when it is subjected to the action of chloroform. In these backward and forward movements, on the lower surface of the buccal segment, a tuft of long transparent filaments may be seen to project, sometimes finely striated transversely and of an extreme slenderness. These setiform elements, which are much longer than the cephalic lobe and very flexible, have not, to my knowledge, been noticed in any Lumbrician. Must they be regarded as homologous with the cylindrical bacilli described by Perrier in the interior of the hypodermis of the *Pontodrili*? or are they really muscular fibres ruptured and dissociated by the reagent?

The ovoid pharyngeal swelling extends from the third to the fifth segment; it is followed by a straight œsophagus, which, in segments 10, 11, 12, and 13, presents four dilatations, taking the place of the gizzard. The intestine, properly so-called, commences at the fourteenth segment. In the anterior region (segments 5 to 9) the œsophagus is covered laterally and dorsally by voluminous glands, which decrease posteriorly; the smallest is situated in the ninth segment. I regard these as homologous with the septal glands discovered by Vejdovsky in the Enchytræidæ. Notwithstanding the place which they occupy against the intestine, these organs are not digestive glands; they open on the outside of the back, and I think that it is to their secretion that the luminous property of the *Photodrilus* must be attributed. The dissepiments do not always correspond exactly with the limit of two consecutive segments. Thus the ninth septum is not situated between the ninth and the tenth segments, but it is attached to the intestinal wall, towards the middle of the tenth; in the same manner the tenth, eleventh, and twelfth septa start from a lateral insertion situated a little below the lower limit of the tenth, eleventh, and twelfth segments, and surround the intestine towards the middle of the eleventh, twelfth, and thirteenth segments. The same fact has been remarked by Horst in *Moniligaster Houtenii*.

The circulatory apparatus differs little from that of the *Pontodrili*. The lateral hearts are situated in segments 10, 11, and 12. The ventral vessel is divided, towards the middle of the 8th segment, into two lateral ventral branches, which, at first very widely separated, converge in segments 5 and 4, and are then directed laterally into segments 2 and 1, to form a fine vascular plexus in the cephalic lobe.

There are two pairs of testes. They are large, very vascular glands, which occupy the upper part of segments 11 and 12. The ovaries are situated in the thirteenth segment. The animals which we have studied not being at the period of sexual activity, the male genital apertures were not very distinct. The apertures of the oviducts were to be seen very clearly on the lower surface of the fourteenth segment, in the form of two little fissures, slightly oblique from without inwards. The copulatory pouches, situated in the ninth segment, have a small accessory sac, as in the *Pontodrili*.

In certain individuals, in the twelfth and sometimes in the thirteenth and eighteenth segment, besides the eight ordinary setæ, two complementary setæ may be seen, situated lower down than the others and placed outside the lower ventral rows; sometimes one of these setæ is replaced by a bundle of four setæ, and that sometimes to the right, sometimes to the left. Horst seems to have met with similar tetrachetal bundles in the *Rhinodrilus Zenkatei*. Are these penial setæ in retrogression?

The short description which Dugès has given of his *Lumbricus phosphoreus** may apply to the *Photodrilus*. Dugès found this species in the tan of a hothouse in the Jardin des Plantes at

* Ann. des Sc. Nat. 2e série, t. viii. p. 24 (1837).

Montpellier. At Wimereux the *Photodrilus* is only to be met with in the paths running along the beds filled with soil from the hot-houses of an horticulturist at Boulogne. It is probable therefore that we have to do with an exotic species which has accommodated itself very well to the maritime climate of the Boulonnais.—*Comptes Rendus*, November 7, 1887, p. 872.

Note on a new Species of Cercopithecus *from Kaffa, in Central Africa.* By Dr. Enrico H. Giglioli.

The Royal Museum of Florence has lately received from Dr. Leopoldo Traversi some important collections, among which occurs a monkey evidently belonging to a still undescribed species. It is an adult female, and comes from Kaffa; Dr. Traversi has sent the skin and the skeleton.

This monkey belongs to Schlegel's group vi. of *Cercopithecus* (Monogr. des Singes, p. 82, Leyden, 1876), which includes species with the hair black, "annulated with greyish or reddish white upon the upper part of the body, the cheeks, and the basal part of the tail," and in which Schlegel has placed two species, namely *C. leucampyx*, Fischer, and *C. neglectus*, Schlegel. The former lives in Angola, has the forehead white, and received from Gray the name of *C. Pluto* (P. Z. S. 1848, p. 57). The second inhabits the region of the White Nile, and was regarded by Gray (Cat. Monkeys, Lemurs, &c. B. M. p. 22, 1870) as the true *C. leucampyx*, but differs therefrom, as noted by Schlegel (*op. cit.* p. 70), by having the anterior margin of the thighs and a band across the hips white.

The species here described differs clearly from the two above cited by the deficiency of the white bands across the forehead, upon the anterior margin of the thighs, and across the hips. On the other hand it has the anterior part of the neck, the sparse hairs of the upper lip, and the longer and more abundant hairs of the chin of a yellowish white. The greyish annulations, with a greenish tinge in some parts, are to be noted upon the hairs of the forehead, the long hairs of the cheeks, the hairs which adorn the outer margins of the ears, on all the lower part of the back, and on the basal third of the tail. The crown of the head, the nape, the upper part of the back, the limbs, and the terminal portion of the tail have the hair of an intense black colour, which changes to a fuliginous brown on the breast, the abdomen, and the inner parts of the thighs and legs. The naked skin of the face was evidently of an azure-blue colour in the living animal. The hairs are scarce towards the extremity of the tail and on the fingers.

The dimensions are as follows:—Total length (from the vertex to the end of the tail) 0·880 m.; tail 0·390 m.; arm (from the axilla to the end of the middle finger) 0·170 m.; leg (from the groin to the extremity of the toes) 0·270 m. The bones show no differential characters.

The author proposes to name this species *Cercopithecus Boutourlinii*, after the Count Augusto Boutourline, of Florence.—*Zoologischer Anzeiger*, No. 261, September 26, 1887, p. 509.

On the Formation of the Calcareous Corpuscles in Holothuria.
By M. Edgard Hérouard.

In studying the calcareous corpuscles in the Dendrochirotæ, of which a considerable number of species are found at Banyuls and at Roscoff, I have been led to discover their mode of formation; and, though these elements present in each species a form so peculiar that it serves as a criterion in their determination, I have found that the original form of the corpuscle is everywhere the same in these animals.

A calcareous corpuscle has, in fact, as the basis of its formation, a group of hexagonal prismatic cells, arranged in a single layer, in a pavement-like form.

Four adjacent cells, and in the first place their walls of contact, serve as a centre of attraction for the calcareous molecules. Thus, at first, we get a corpuscle in the form of an X. The calcareous matter afterwards reaches the other lateral walls of these four cells; but the bases of the latter always remain free from any deposit. The centre of each cell is occupied by the nucleus, and the presence of this, preventing the calcareous deposit from spreading, explains the existence of holes in their structures. The calcareous deposit being more abundant along the edges of the hexagonal cells is the cause of the existence of the projections which occur on the surface of the corpuscles.

I shall call these four cells the *four fundamental cells of the corpuscle*, and give the name of the *fundamental calcareous corpuscle* to that which originates by the calcification of the lateral walls of these four cells. As a type of this *fundamental corpuscle* may be cited the normal corpuscle of *Colochirus Lacazii*.

Because the mode of formation is subjected to the same law, it does not follow that the fundamental calcareous corpuscle is identical in all species. The size, relative or absolute, of the hexagonal cells, the form and dimensions of the projections from the surface of the corpuscle are, in fact, matters which are fixed for each species, but vary in different species.

When once a fundamental calcareous corpuscle is formed, a calcification analogous to that above described gains the neighbouring hexagonal cells one after the other. According to the species this calcification either equally affects all the cells which surround this corpuscle, or only some of them. Thus we get corpuscles representing sometimes discs, sometimes laminæ, and more or less elongated and contorted.

In general, among the holes in the more complex calcareous corpuscles, we may distinguish four, which, by their size and their lozenge-shaped arrangement, strike one at once. They are precisely those of the fundamental calcareous corpuscle.

To sum up, in the Dendrochirotæ:—(1) The calcareous corpuscles have as their basis of formation a plane of hexagonal cells; (2) only four adjacent cells are concerned in the commencement of the formation of every corpuscle, and thus furnish the *fundamental calcareous corpuscle*; (3) the apertures in the corpuscles are caused by the presence of the nuclei of the hexagonal cells; (4) the projections of the surface of the corpuscles are formed along the edges of the hexagonal cells.—*Comptes Rendus*, November 7, 1887, p. 875.

INDEX TO VOL. XX.

Acythopeus, new species of, 359.
Ædiodes, new species of, 117.
Æga crenulata, note on, 444.
Agathia, new species of, 243.
Alcides, new species of, 354.
Algæ, Ceylonese, in the British Museum, Catalogue of, 21.
Amblypodia, new species of, 268.
Ambulyx, new species of, 271.
Amœbæ, on multiplication in, 316.
Amphiura Chiajii, on the variations of, 411.
—— squamata, on a Copepod parasitic upon, 148.
Anisodes, new species of, 245.
Anniella, new species of, 50.
Anomalurus, new species of, 440.
Apis mellifica, on the races of, 143.
Aporrhipis, characters of the new genus, 18.
Appendicularians, on swarms of, 102.
Appias, new species of, 265, 434.
Argonauta Böttgeri, notes on, 409.
Aristosuchus pusillus, on, 135.
Aulax, new species of, 250.
Axinella Donnani, remarks on, 158.
Baris, new species of, 359.
Barsenis, characters of the new genus, 17.
Batrachia, new, 50, 95, 295, 312, 344, 407.
Batrachospermum, new species of, 41.
Beddard, F. E., on a new type of compound eye, 233.
Bee, on the races of the honey-, 143.
Bell, Prof. F. J., on a new species of Nucleolites, with remarks on the subdivisions of the genus, 125; on the generic name Muelleria, 148; on the habitat of Peripatus Leuckarti, 252; on a new species of Evechinus, 403; on the variations of Amphiura Chiajii, 411.
Bergendal, Dr. D., notes on the Land-Planariæ, 44.
Bernard, F., on the structure of the branchia of the prosobranchiate Gasteropods, 247.
Beryx, new species of, 237.
Bipalia, notes on, 44.
Bird, on a sacrum, apparently indicating a new type of, 137.
Blochmann, Dr. F., on the sexual generation of Chermes abietis, 390.
Blood-corpuscles of the Cyclostomata, on the, 231.
Böhmig, Dr. L., on the sense-organs of the Turbellaria, 308.
Bonnier, J., on the phylogeny of the Bopyrinæ, 76.
Books, new: — Balfour's 'Agricultural Pests of India,' 74.
Bopyrinæ, on the phylogeny of the, 76.
Bothrideres, new species of, 9.
Botys, new species of, 123.
Boulenger, G. A., on new Reptiles and Batrachians, 50, 95, 152, 295, 407, 413; list of Lizards and Batrachians from Cyprus, 344; on the affinity of the North-American lizard-fauna, 345; on Cophophryne sikkimensis, 405.
Brady, H. B., on the so-called "soapstone" of Fiji, 443.
Branchia, on the structure of the, of the prosobranchiate Gasteropods, 247.
Brodie, Rev. P. B., on the mode of occurrence of fishes in the Keuper of Warwick and Nottingham, 139.
Bryozoa, on Australian, 81, 181, 253;

on tertiary Cyclostomatous, from New Zealand, 139.
Buchholzia, new species of, 424.
Bufo, new species of, 52.
—— quadriporcatus, remarks on, 314.
Butler, A. G., on new Lepidoptera from the Solomon Islands, 114, 240, 414; on a new genus of Chalcosiid moths allied to Pedoptila, 180.
Byssal organ of the Lamellibranchiata, on the, 318.
Cacosternum, characters of the new genus, 51.
Cancerilla tubulata, notes on, 148.
Carchares, characters of the new genus, 12.
Cediocera, characters of the new genus, 20.
Cephalopoda, on the salivary glands in the, 251.
Cercopithecus, new species of, 449.
Chætopterus, on the organization of, 146.
Chalcidoptera, characters of the new genus, 119.
Chalininæ, on the new system of, 326; on the classification and nomenclature of, 428.
Chariotheca, new species of, 17.
Chermes abietis, on the sexual generation of, 390.
Chilodon, new species of, 105.
Chondrosteus acipenseroides, on, 134.
Cicadidæ, new species of, 226, 415.
Clada, characters of the new genus, 9.
Cladorhiza, new species of, 279.
Clione borealis, on the occurrence of, 103.
Cœlenterate, on a new, 203.
Coleoptera, new, 8, 53, 165, 338, 348.
Copepod, on a, parasitic upon Amphiura squamata, 148.
Cophophryne sikkimensis, on, 405.
Corinea, new species of, 414.
Cosmopsaltria, new species of, 229.
Cossyphus, new species of, 13.
Cotochena, new species of, 122.
Cribrilina, new species of, 187.
Cryptotympana, new species of, 415.
Ctimene, new species of, 241.
Curculionidæ, on new Asiatic, 348.
Cyclobatis, on the affinities of, from the Cretaceous of Mount Lebanon, 389.
Cyclostomata, on the blood-corpuscles of the, 231.
Cyrtotriplax, new species of, 62.
Cyrtotyche, new species of, 14.
Dacne, new species of, 56.
Davis, J. W., on Chondrosteus acipenseroides, 134.
Day, F., on the Zygæna dissimilis of Murray, 389.
Decetia, new species of, 242.
Delias, new species of, 266.
Dendrohyrax, new species of, 440.
Dendroides, new species of, 174.
Dendy, A., on the sponge-fauna of Madras, 153; on a new species of Cladorhiza, 279; on the new system of Chalininæ, 326.
Dermatodes, new species of, 349.
Desmia ægimiusalis, new variety of, 117.
Dinosaurian remains, note on some, 141.
Diplopoda, on the classification of the, 283.
Dirodes, characters of the new genus, 352.
Distant, W. L., on new species of Cicadidæ, 226, 415; on Sphingidæ from the Malay peninsula, and on a new species of Ambulyx, 270.
Diurus, new species of, 19.
Donald, Miss J., on some Carboniferous species of Murchisonia, 140.
Doryagus, characters of the new genus, 12.
Draco, new species of, 95.
Duncan, Prof. P. M., on the Echinoidea from the Australian tertiaries, 140.
Dutilleul, G., on the anatomy of the Rhynchobdellean Hirudinea, 150.
Echinodermata, on the true nature of the "madreporic system" of, 321; on the phylogeny and anatomy of the, 361.
Echinoidea from the Australian tertiaries, on the, 140.
Ehlers, Prof. E., on Polyparium ambulans, 273.
Ellobius, new species of, 384.
Enchytræidæ, on the, 417.
Endoceras, new species of, 393.
Episomus, new species of, 349.
Eremias, new species of, 51.

Erotylidæ, on new, from Japan, 53.
Ettingshausen, Dr. C. Baron v., on the Tertiary flora of Australia, 142.
Eudæmonius, characters of the new genus, 72.
Eugeusis, new species of, 10.
Eupagurus Bernhardus, on parasitic castration in, 78.
Euphlœus, characters of the new genus, 15.
Euplotes, new species of, 113.
Euschema, new species of, 240.
Euthycus, new species of, 353.
Eutriplax, characters of the new genus, 72, 342.
Evechinus, new species of, 403.
Exætoderes, characters of the new genus, 354.
Eye, on a new type of compound, 233.
Fiedler, K., on the development of the sexual products in Spongilla, 435.
Fins, on the colour of pelvic, 300.
Fishes, on the significance of the yolk in the eggs of osseous, 1; on Australian, of the genus Beryx, 237; on post-larval food-, 303; on some electrical, 441.
Flora, on the Tertiary, of Australia, 142.
Flustra, new species of, 93.
Foord, A. H., on Orthoceras [Endoceras] duplex, 393.
Frogs, on new South-American, 295.
Gall-fly, on a new, 250.
Gasteropods, on the structure of the branchia of the prosobranchiate, 247.
Gebia stellata, on parasitic castration in, 78.
Geological Society, proceedings of the, 134, 443.
Gerbillus, on a species of, 382.
Giard, A., on the phylogeny of the Bopyrinæ, 76; on parasitic castration in Eupagurus Bernhardus and in Gebia stellata, 78; on a Copepod parasitic upon Amphiura squamata, 148; on a new genus of phosphorescent Lumbricidæ, and on the type-species, Photodrilus phosphoreus, 446.
Giglioli, Dr. E. H., on a new species of Cercopithecus, 449.
Glossiphonia, on the anatomy of, 150.
Glyphodes, new species of, 118.
Groom, T. T., on some new features in Pelanechinus corallinus, 143.
Günther, Dr. A., note on the Hapuku of New Zealand, 236; on Australian fishes of the genus Beryx, 237; on Batrachians from Perak, 312.
Halichondria panicea, new variety of, 157.
Halymenia, new species of, 23.
Hamann, Dr. O., on the anatomy and phylogeny of the Echinodermata, 361.
Hapuku, note on the, of New Zealand, 236.
Haritala, new species of, 122.
Hartog, Prof. M. M., on the "madreporic system" of Echinodermata, with remarks on nephridia, 321.
Helicarion, new species of, 131.
Helix, new species of, 132.
Hérouard, E., on the formation of the calcareous corpuscles in the Holothuria, 450.
Heterocnephes, new species of, 118.
Heterosuchus valdensis, on, 136.
Hircinia, new species of, 163.
Hirudinea, on the anatomy of the Rhynchobdellean, 150.
Histrio, new species of, 113.
Holman, Miss L. E., on multiplication in Amœbæ, 316.
Holosticha, new species of, 108.
Holothuria, on the formation of the calcareous corpuscles in, 450.
Homoptera, new, 226, 415.
Hulke, J. W., on some Dinosaurian remains, 141.
Huxley, Prof. T. H., on Hyperodapedon Gordoni, 137.
Hyla, new species of, 53, 298.
Hylobius, new species of, 350.
Hyperodapedon Gordoni, observations on, 137.
Hypochæris radicata, L., on a new gall-fly infesting, 250.
Hyponomeutidæ, new species of, 414.
Immedia, new species of, 15.
Infusoria, on new hypotrichous, from American fresh waters, 104.
Iotrochota baculifera, new variety of, 158.

Isopoda, on the structure of the eye in certain, 233.
Ixalus, new species of, 97.
Joubin, L., on the salivary glands in the Cephalopoda, 251.
Kieffer, J. J., on Aulax hypochæridis, 250.
Korotneff, Dr. A., on Polyparium ambulans, 203.
Labrus, on a post-larval, 300.
Laffuie, M. J.-, on the organization of Chætopterus, 146.
Lamellibranchiata, on the byssal organ of the, 318.
Lendenfeld, Dr. R. von, on the Chalininæ, 428.
Lepidoptera, new, 114, 129, 180, 240, 265, 270, 414, 432.
Lepralia, new species of, 194.
Leptopoma, new species of, 133.
Leptopsaltria, new species of, 228.
Lett, Rev. H. W., on the races of the honey-bee, 143.
Lewis, G., on Japanese Erotylidæ, 53; on Japanese Pyrochroidæ, 165; on Japanese Silphidæ, 338.
Liparis Montagui, on the post-larval condition of, 302.
Litonotus, new species of, 104.
Litorhynchus, new species of, 413.
Lizards, list of, from Cyprus, 344.
Lizard-fauna, on the affinity of the North-American, 345.
Loxodes, new species of, 106.
Lumbricidæ, on a new genus of phosphorescent, 446.
Lyssidia, new species of, 241.
Lystrus, new species of, 361.
M'Intosh, Prof., on the occurrence of peculiar gelatinous bodies, 97; on Syncoryne decipiens, 99; on the commensalistic habits of the larval forms of Peachia, 101; on the presence of swarms of Appendicularians, 102; on the occurrence of Clione borealis, 103; on a post-larval Labrus, with remarks on the colour of pelvic fins, 300; on the post-larval condition of Liparis Montagui, 302; on a peculiar Teleostean yolk-sac, 302; on post-larval food-fishes, 303.
Mammalia, new, 269, 378, 440.
Matthews, J. D., on Ægа crenulata, 444; on Sebastes norvegicus, 445.
Melitæa, new species of, 130.
Mesenchytræus, new species of ,423.
Messaras, new species of, 267.
Metaporia, new species of, 129.
Michaelsen, Dr. W., on the Enchytræidæ, 417.
Microdon nuchalis, on the so-called, 342.
Micropora, new species of, 185.
Microsca, new species of, 116.
Microsternus, new species of, 57.
Mollusca, new, 130.
Mucronella Elleri, new variety of, 194.
Muelleria, on the generic name, 148.
Müller, Dr. W., on the scent-organs in Phryganidæ, 305.
Murchisonia, on some Carboniferous species of, 140.
Murray, G., on Ceylonese Algæ in the British Museum, 21.
Murray, J. A., on a new species of Zygæna, 304.
Mus, new species of, 269.
Nanina, new species of, 131.
Necrophorus, new species of, 340.
Neotriplax, characters of the new genus, 60.
Nephridia, remarks on, 321.
Newton, E. J., on the remains of fishes from the Keuper of Warwick and Nottingham, 139.
Nosophora, new species of, 120.
Nucleolites, on the genus, with descriptions of new species, 125.
Ochodontia, new species of, 245.
Omiodes, new species of, 121.
Omosaurus, new species of, 141.
Onychodromopsis, characters of the new genus, 107.
Ophthalmodes, new species of, 242.
Ornithodesmus cluniculus, on the sacrum of, 137.
Ornithopsis, new species of, 141.
Ornithorhynchus paradoxus, on a newly-excluded young of the, 249.
Orthoceras duplex, on, 393; new species of, 402.
Owen, Sir R., on a newly-excluded young of the Ornithorhynchus paradoxus, 249.
Oxytricha, new species of, 110.
Paduca, new species of, 266.
Paludicola, new species of, 296.
Papilio, new species of, 432.

Parasitic castration, on, in the decapod Crustacea, 78.
Pascoe, F. P., on new genera and species of Coleoptera, 8; on new Asiatic Curculionidæ, 348.
Patricosaurus merocratus, on, 136.
Peachia, on the commensalistic habits of the larval forms of, 101.
Pelanechinus corallinus, on some new features in, 143.
Peripatus Leuckarti, on the habitat of, 252.
Phakellia, new species of, 159.
Pharambara, new species of, 117.
Photodrilus, characters of the new genus, 446.
Phryganidæ, on the scent-organs in, 305.
Phrynella pulchra, remarks on, 313.
Pimplema, characters of the new genus, 16.
Planariæ, notes on the land-, 44.
Platax, on a new species of, 342.
Pleonectusa, new species of, 124.
Pocock, R. I., on a new genus and species of Polyzonidæ, 222; on the classification of the Diplopoda, 283.
Pœcilopsaltria, new species of, 226.
Polyparium ambulans, on, 203, 273.
Polypedates, new species of, 315.
Polyprion prognathus, remarks on, 236.
Polyzoa, notes on some, from the Lias, 142.
Polyzonidæ, on a new genus and species of, 222.
Pomponia, new species of, 230.
Porina, new species of, 190.
Prince, E. E., on the significance of the yolk in the eggs of osseous fishes, 1.
Pseudodesmus, characters of the new genus, 222.
Pyralis, new species of, 115.
Pyrochroa, new species of, 169.
Rana, new species of, 96.
Raspailia, new species of, 160.
Regadia, new species of, 435.
Reichel, L., on the byssal organ of the Lamellibranchiata, 318.
Remodes, new species of, 247.
Renania, characters of the new genus, 60.
Reptiles, new, 50, 95, 413; on some, from Sumatra, 152; from near Muscat, 407.
Rhynchopora, new species of, 195.
Royal Institution, proceedings of the, 441.
Salivary glands, on the, in the Cephalopoda, 251.
Sanderson, Prof. J. S. B., on some electrical fishes, 441.
Satelia, characters of the new genus, 73.
Scent-organs in Phryganidæ, on the, 305.
Schizoporella, new species of, 193.
Schizotus, new species of, 172.
Sciurus, new species of, 127.
Scully, J., on the mammals collected in Northern Afghanistan, 378.
Sebastes norvegicus, note on, 445.
Seeley, Prof. H. G., on Aristosuchus pusillus, 135; on Heterosuchus valdensis, 136; on Patricosaurus merocratus, 136; on a sacrum, apparently indicating a new type of bird, 137.
Selasia, new species of, 11.
Semionotus, new species of, 175, 320.
Semioptila, characters of the new genus, 180.
Serolis, on the structure of the eye in, 234.
Shells, on new species of land-, 130.
Silphidæ, on Japanese, 338.
Smith, E. A., on new species of land-shells, 130; on Volutharpa Perryi, 347; on Argonauta Böttgeri, 409.
Smith, H. G., on new species of Lepidoptera, 129, 265, 432.
Spermophilus, new species of, 381.
Sphingidæ from the Malay peninsula, on, 270.
Spilobotys, characters of the new genus, 123.
Sponge-fauna of Madras, on the, 153.
Spongilla, on the development of the sexual products in, 435.
Stericta, new species of, 115.
Stokes, Dr. A. C., on new freshwater Infusoria, 104.
Strophidia, new species of, 246.
Suberites, new species of, 154.
Syncoryne decipiens, on, 99.

Tachysoma, characters of the new genus, 108.
Thomas, O., on new squirrels, 127; on a new rat, 269; on new Central-African Mammalia, 440.
Thompson, Prof. D'A. W., on the blood-corpuscles of the Cyclostomata, 231.
Triplax, new species of, 69.
Tropidonotus, new species of, 96; on ovo-viviparous generation in, 320.
Turbellaria, on the sense-organs of the, 308.
Uranodoxa, characters of the new genus, 244.
Volutharpa Perryi, notes on, 347.
Walford, E. A., on some Polyzoa from the Lias, 142.
Waters, A. W., on Australian Bryozoa, 81, 181, 253; on tertiary cyclostomatous Bryozoa from New Zealand, 139.
Woodward, A. S., on a new species of Semionotus, 175, 320; on the so-called Microdon nuchalis, 342; on the affinities of Cyclobatis, 389.
Young, H. C., on ovo-viviparous generation in Tropidonotus, 320.
Yphthima, new species of, 267.
Zanclopteryx, new species of, 246.
Zygæna, new species of, 304, 389.

END OF THE TWENTIETH VOLUME.

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CONTENTS OF NUMBER 120.—*Fifth Series.*

Page

LII. On "*Orthoceras* [*Endoceras*] *duplex*," Wahlenberg et auctt., with Descriptions of three new Species of *Endoceras* from the Ordovician of Sweden and Russia contained in the British Museum (Natural History). By Arthur H. Foord, F.G.S. 393

LIII. Description of a new Species of *Evechinus*. By F. Jeffrey Bell, M.A. (Plate XVII. figs. 7 & 8.) 403

LIV. On a rare Himalayan Toad, *Cophophryne sikkimensis*. By G. A. Boulenger 405

LV. A List of the Reptiles and Batrachians obtained near Muscat, Arabia, and presented to the British Museum by Surgeon-Major A. S. G. Jayakar. By G. A. Boulenger 407

LVI. Notes on *Argonauta Böttgeri*. By Edgar A. Smith. (Plate XVII. figs. 1–6.) 409

LVII. Note on the Variations of *Amphiura Chiajii*, Forbes. By F. Jeffrey Bell, M.A. 411

LVIII. Description of a new Snake from Afghanistan. By G. A. Boulenger 413

LIX. Descriptions of two new Species of *Hyponomeutidæ* from the Solomon Islands. By A. G. Butler, F.L.S., F.Z.S., &c. 414

LX. Descriptions of two new Species of *Cicadidæ*. By W. L. Distant 415

LXI. Studies on the *Enchytræidæ*. By Dr. W. Michaelsen. (Plate XVIII.) 417

LXII. Mr. Dendy on the *Chalininæ*. By R. von Lendenfeld .. 428

LXIII. Descriptions of six new Species of Butterflies captured by Mr. John Whitehead at Kina Balu Mountain, North Borneo, in the Collection of Mr. H. Grose Smith. By H. Grose Smith 432

LXIV. On the Development of the Sexual Products in *Spongilla*. By Karl Fiedler 435

LXV. Diagnoses of two new Central-African Mammalia. By Oldfield Thomas 440

PROCEEDINGS OF LEARNED SOCIETIES.

Royal Institution of Great Britain 441

Geological Society 443

MISCELLANEOUS.

Æga crenulata (Lütken). By J. Duncan Matthews, F.R.S.E. 444

Sebastes norvegicus. By J. Duncan Matthews, F.R.S.E. 445

On a new Genus of Phosphorescent Lumbricidæ, and on the Type-species of that Genus, *Photodrilus phosphoreus*, Dugès. By M. A. Giard 446

Note on a new Species of *Cercopithecus* from Kaffa, in Central Africa. By Dr. Enrico H. Giglioli 449

On the Formation of the Calcareous Corpuscles in Holothuria. By M. Edgard Hérouard 450

Index 451

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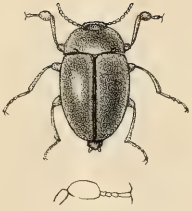

11

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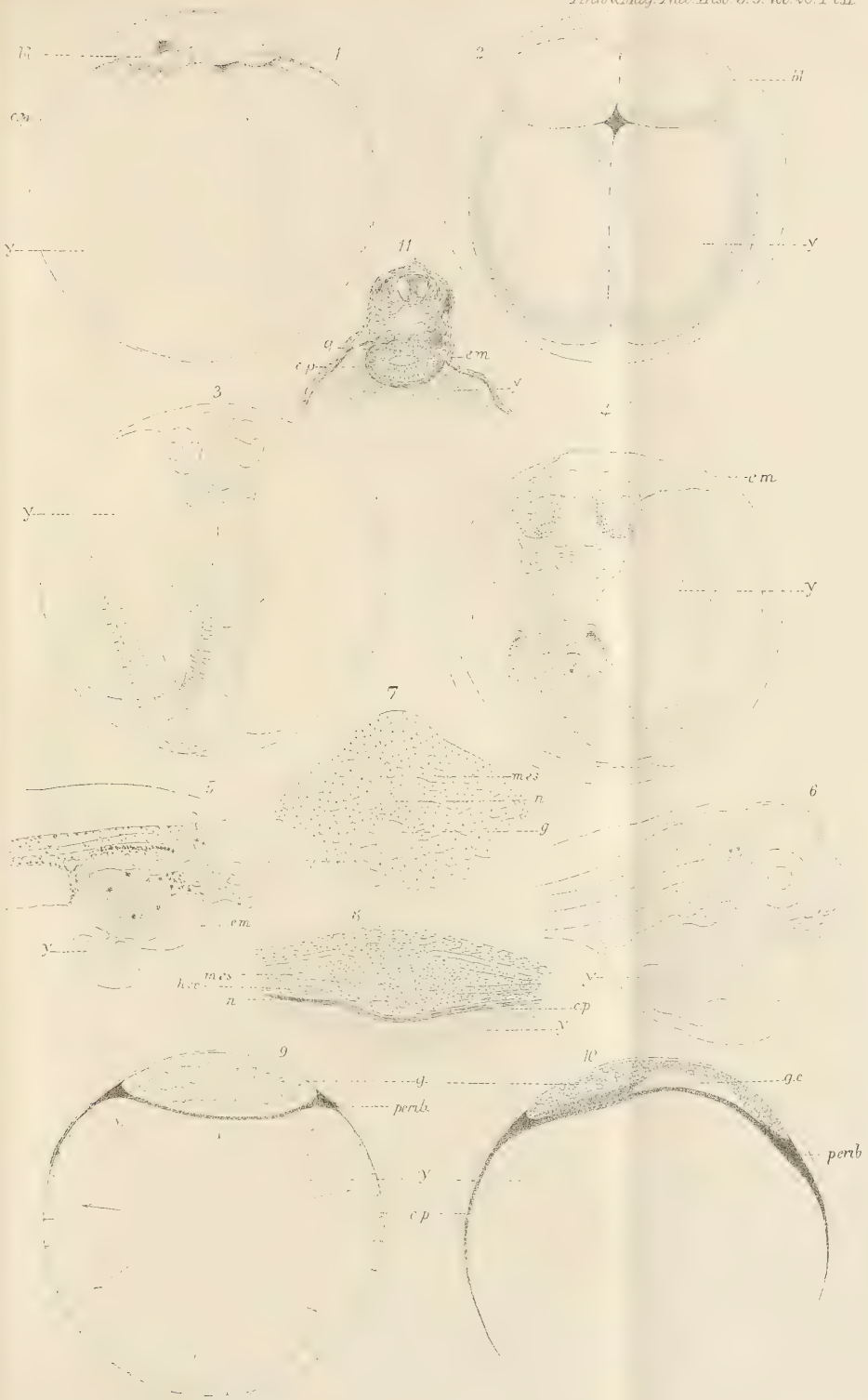
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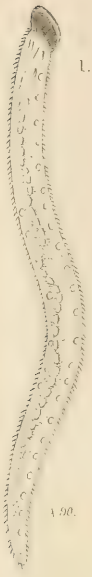
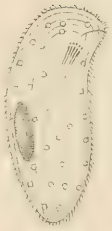
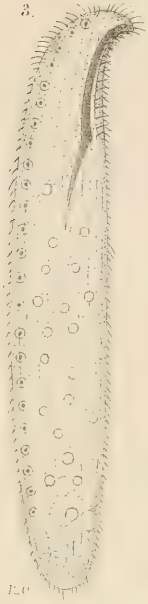
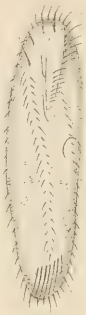

1.
× 90.


2
138.


3.
× 120

4
× 280


5
× 310

6
× 360

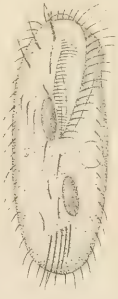
7.
× 415

8
× 360

9.
× 360

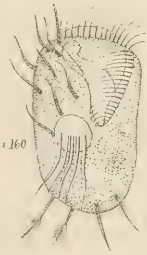
12.
× 360

11.
× 300.

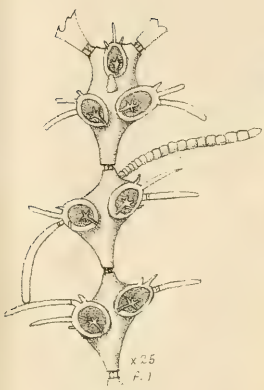

10
× 350.

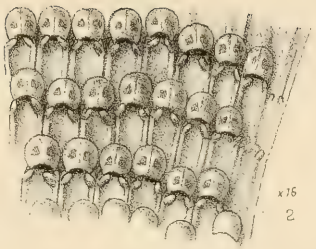
13
× 490

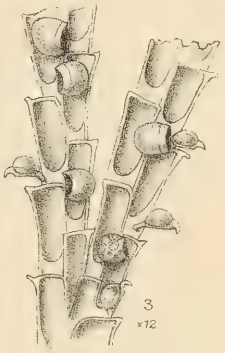
14.
× 256.

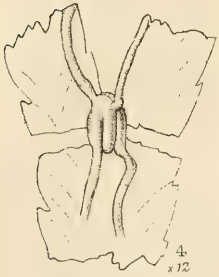

15
× 160

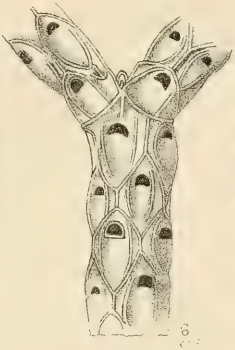
Mintern Bros. lith.

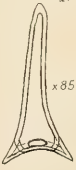


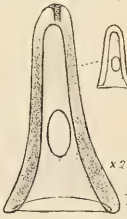


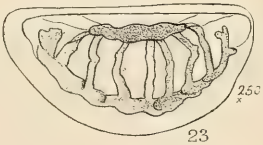








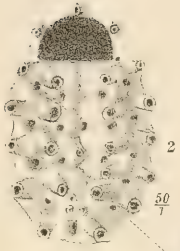


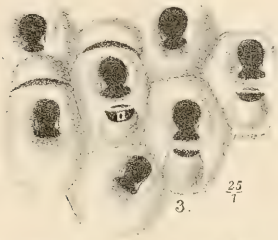


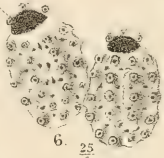
A.W. Waters, del.
A.T. Hollick, lith.

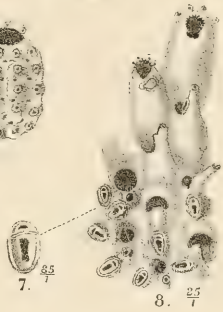
AUSTRALIAN BRYOZOA

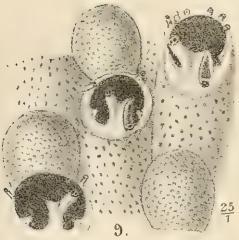
West, Newman & Co imp.

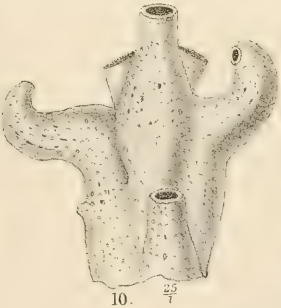


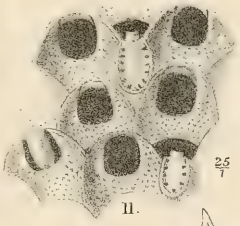


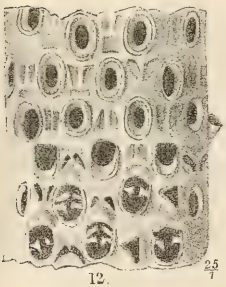


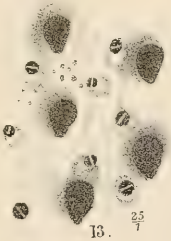


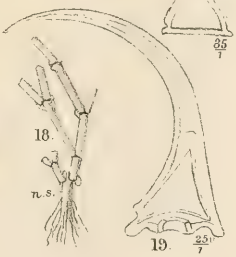






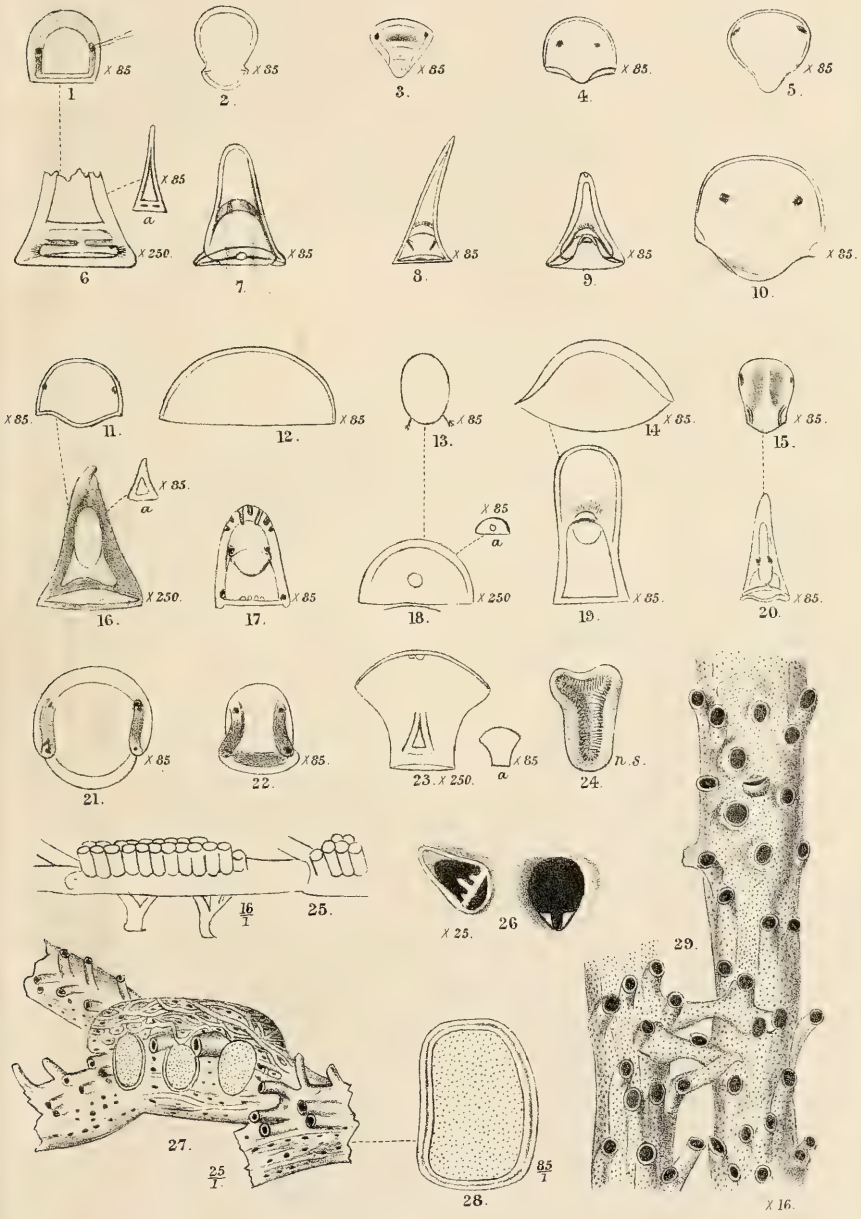






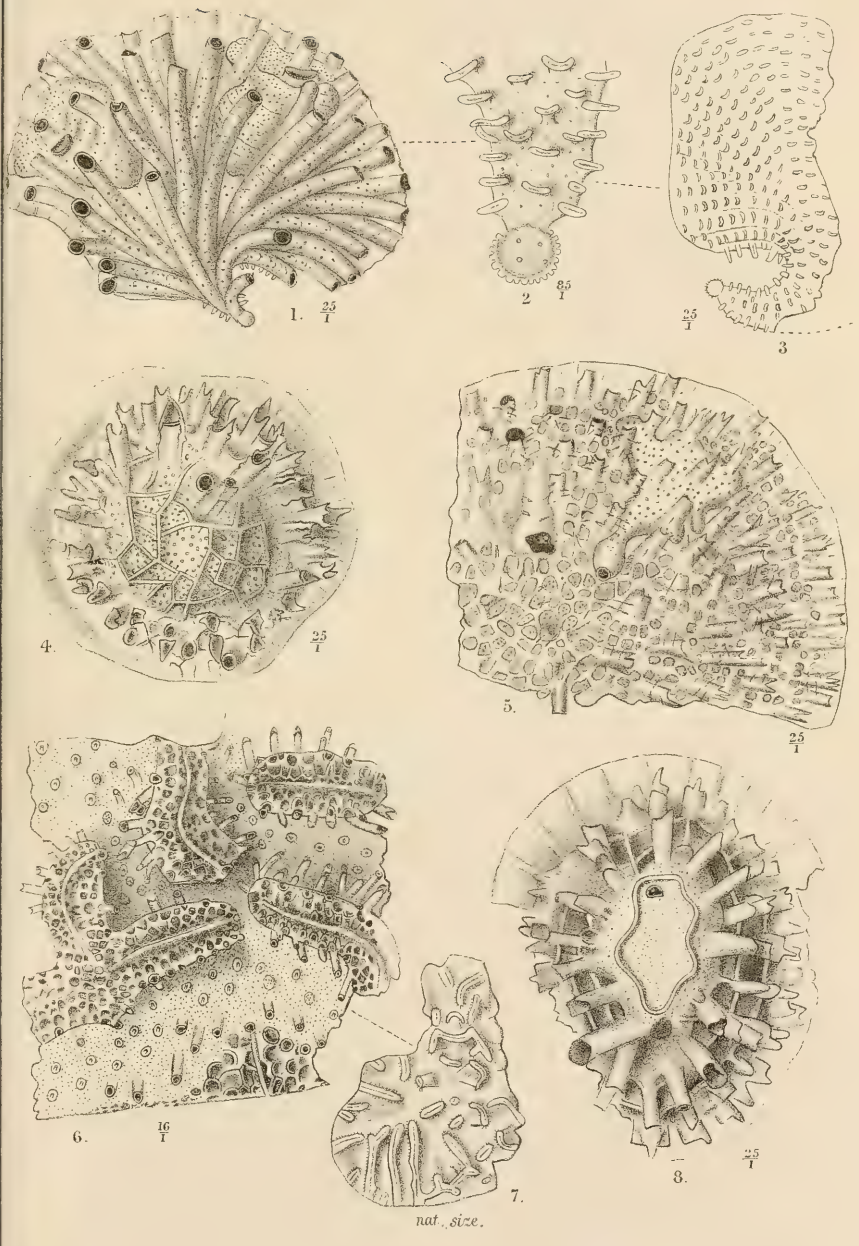
A.W.Waters del. A.T.Hollick lith. Mintern Bros. imp.

AUSTRALIAN BRYOZOA.



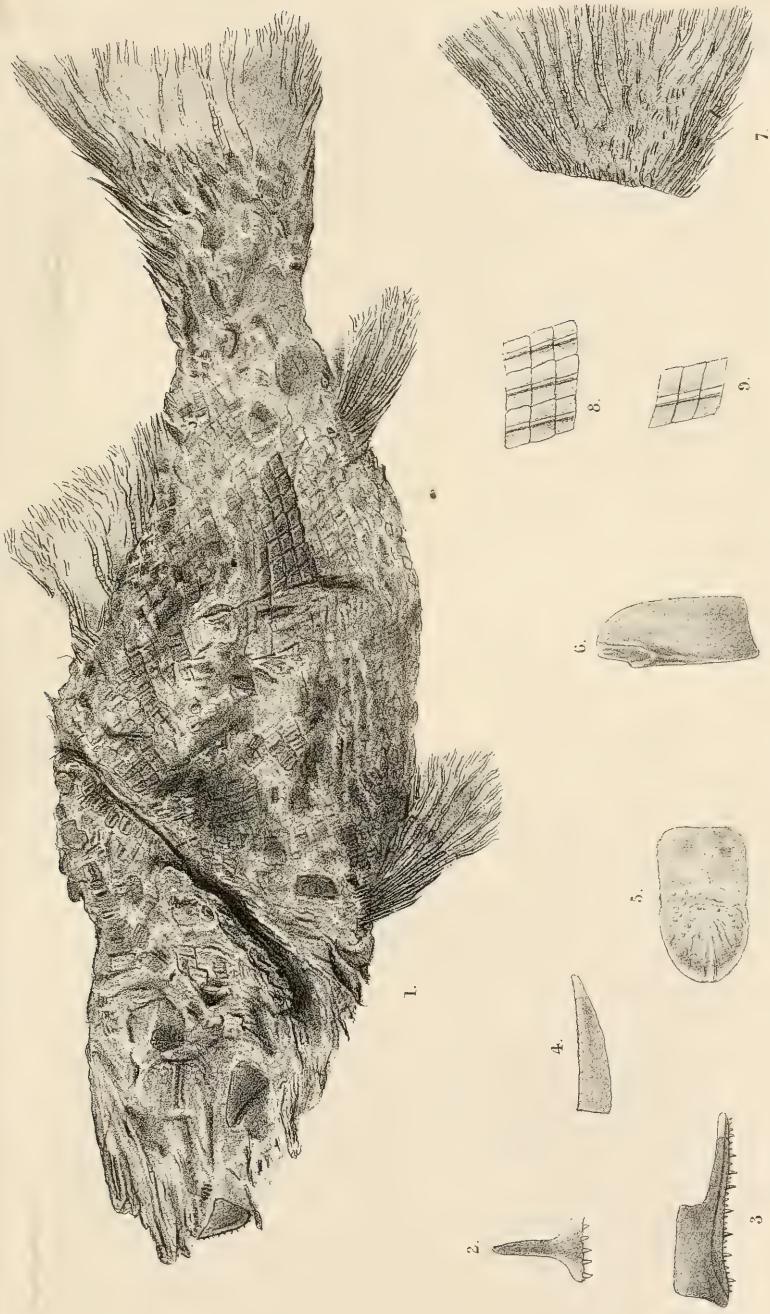
A. W. Waters del. A. T. Hollick lith. Mintern Bros. imp.

AUSTRALIAN BRYOZOA.



A.W.Waters del. A.T.Hollick lith.

Mintern Bros. imp

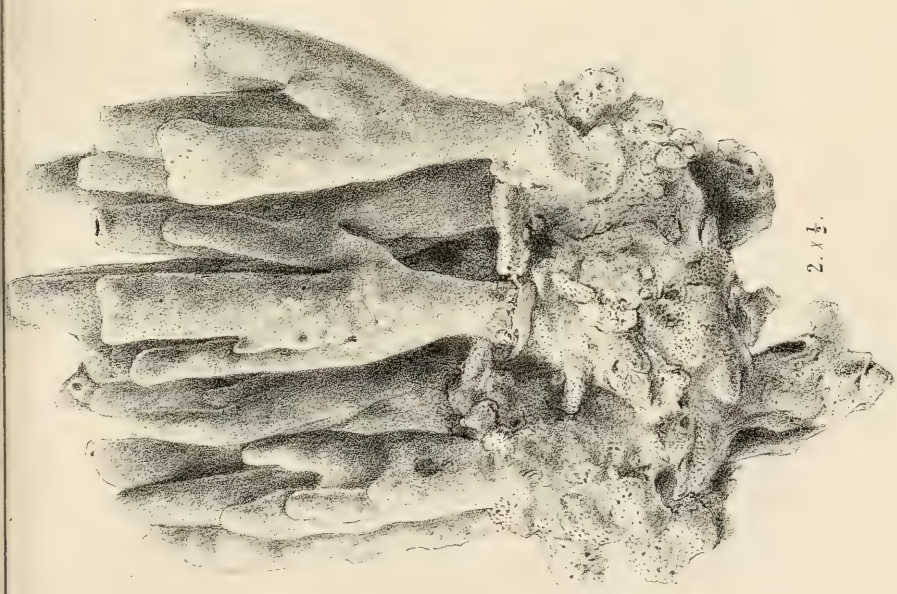


Seminotus Joassi, *A. S. Woodw.*

Mintern Bros. lith.

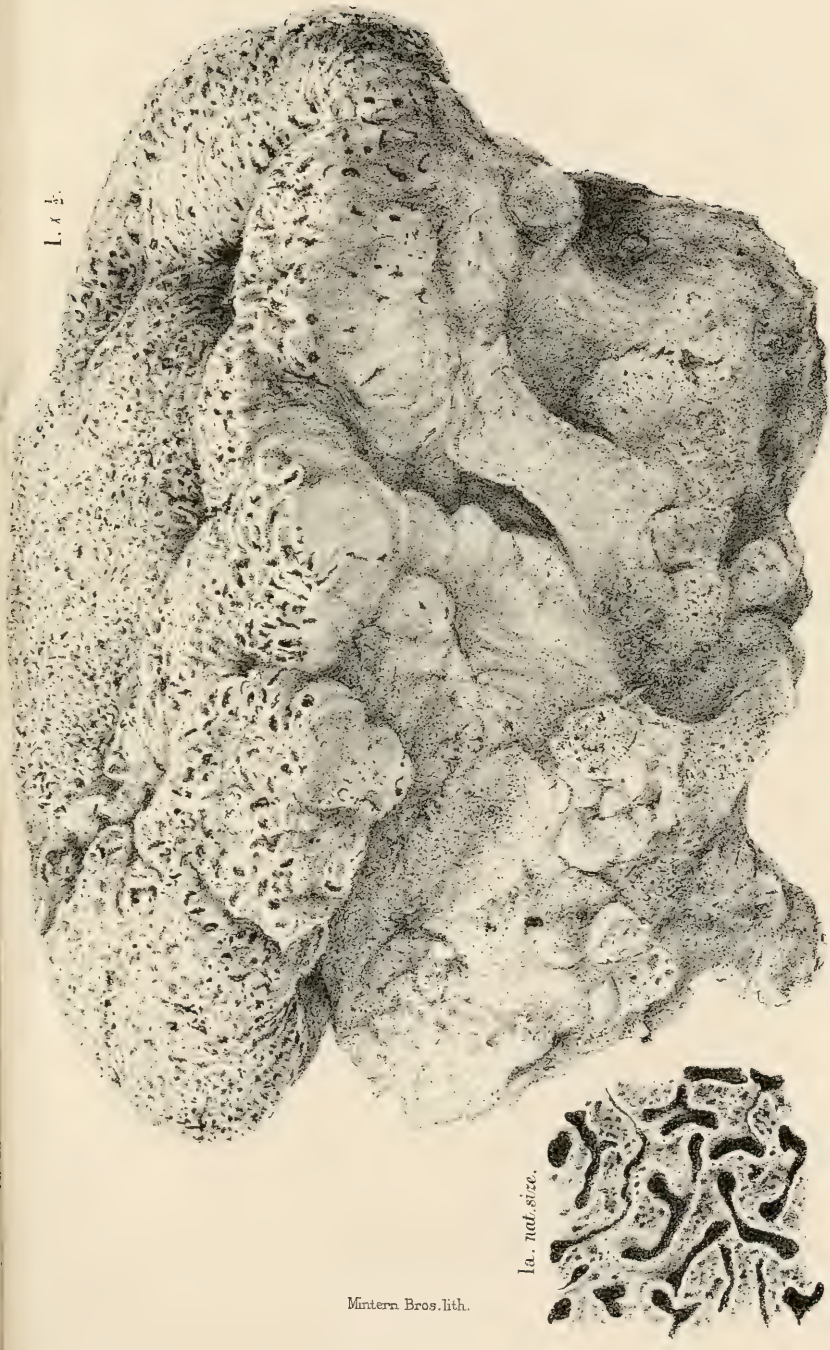
1. × 1½.

1a. × 190.



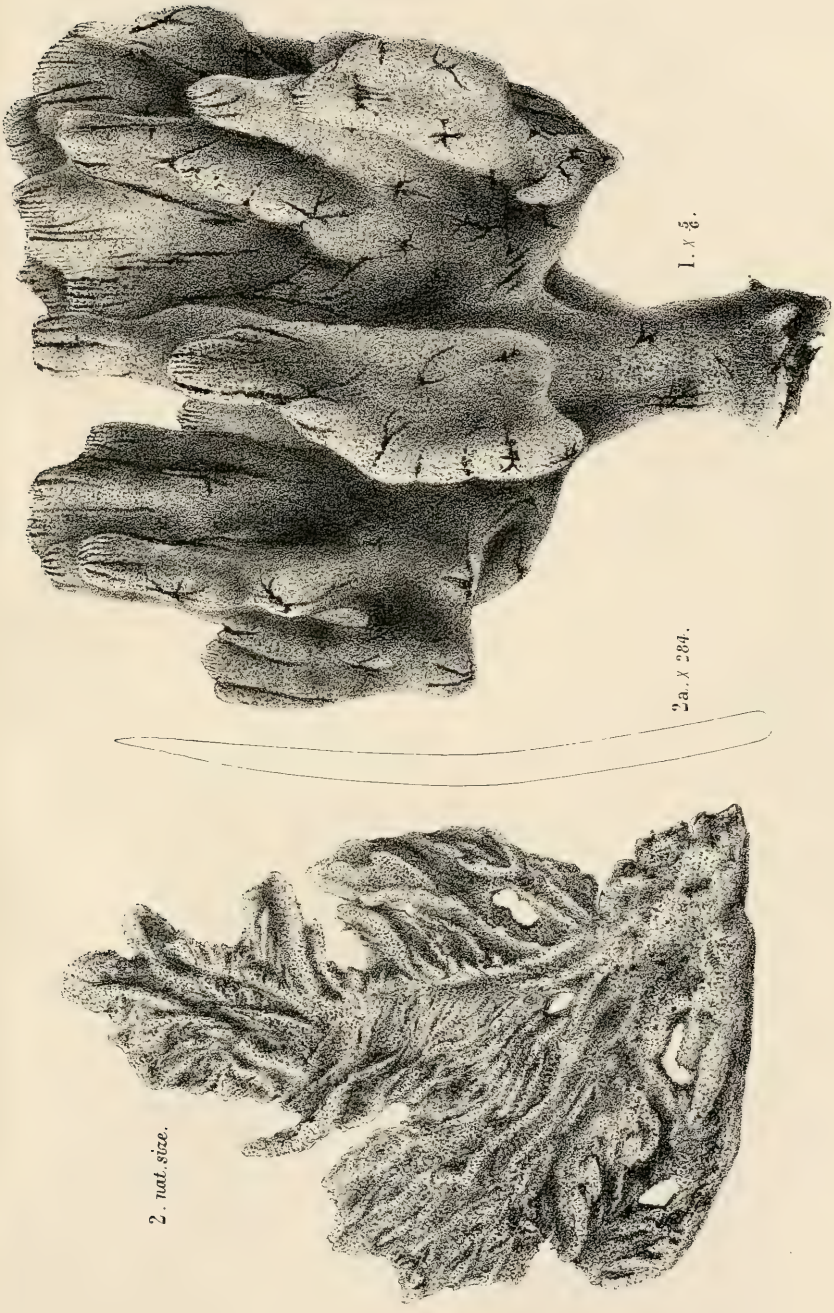
2. × ½.

Mintern Bros. lith.



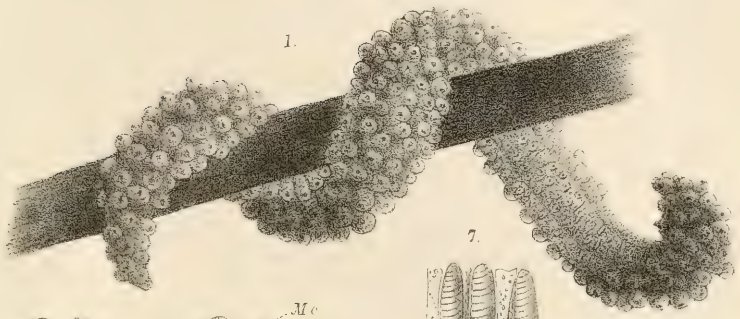
1a. *nat. size.*

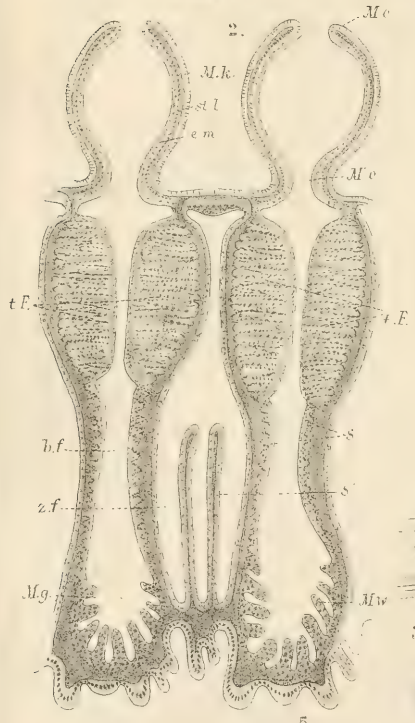
Mintern Bros. lith.

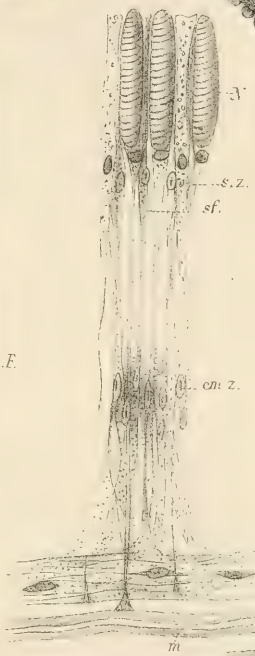


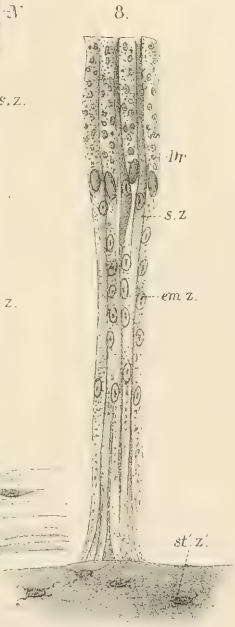
Mintern Bros. lith.

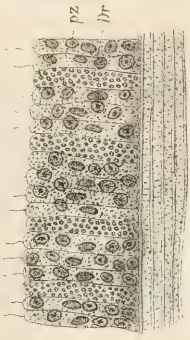
1. x 2/3.
1a. x 264.
1b. x 264.
2. x 2/3.
2a. x 264.





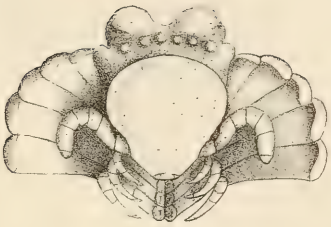






Mintern Bros. lith.

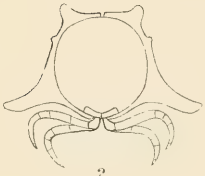
7.



1.

4.

8.

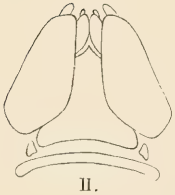


2.

9.

3.

6.



11.

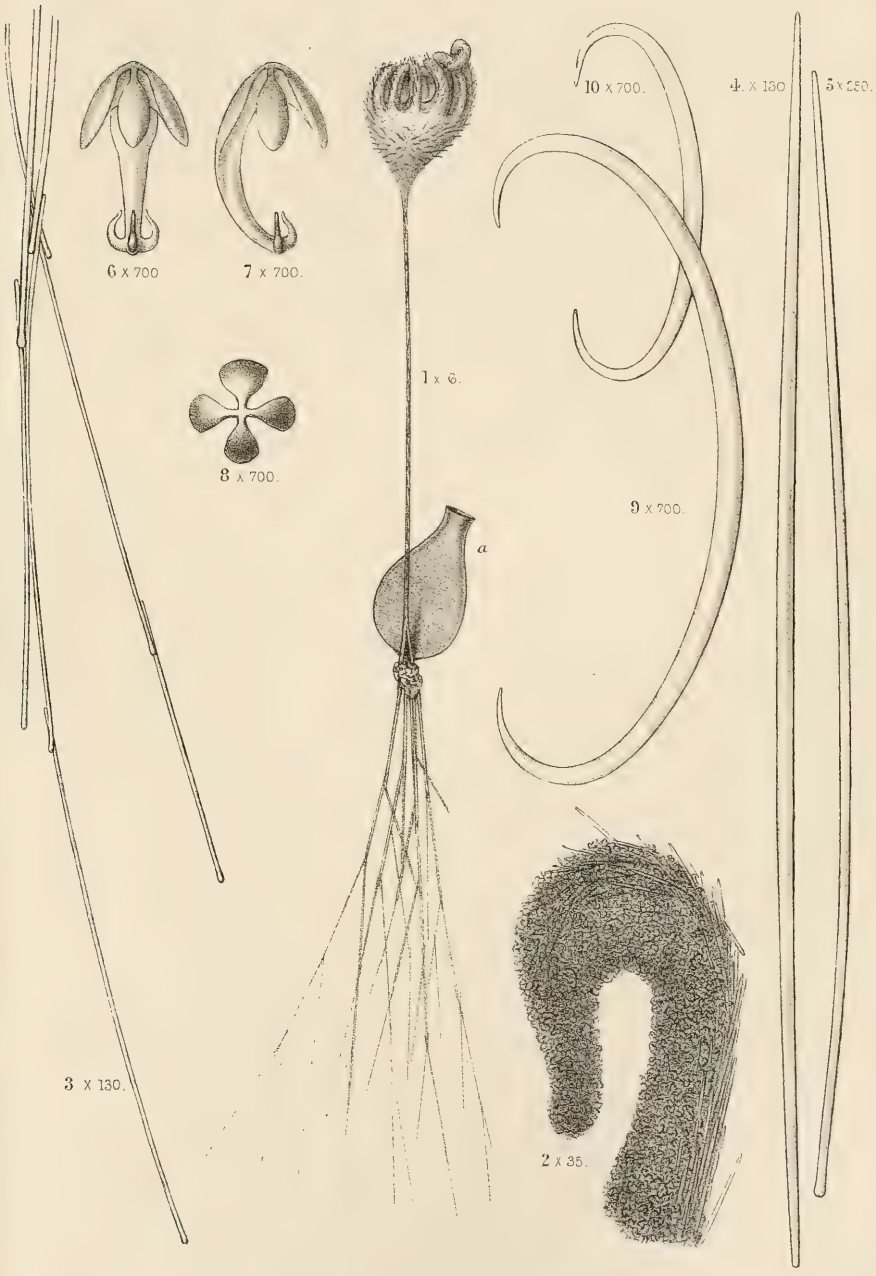
12.

10.

Maud. Horman-Fisher del. et lith.

Mintern Bros. imp.

A NEW GENUS OF POLYZONIDÆ.



A. T. Hollick del. et lith.

Mintern Bros. imp.

Cladorhiza pentacrinus.

R. Mintern del. et lith.

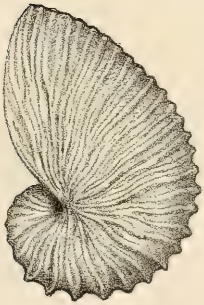
Mintern Bros. imp.

A. Polypedates leprosus. *B. Plurynella pulchra.*
C. Bufo quadriporcatus.

4.

5.

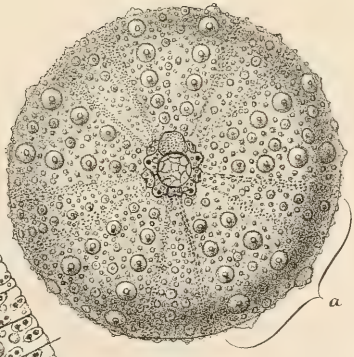
6.



3.

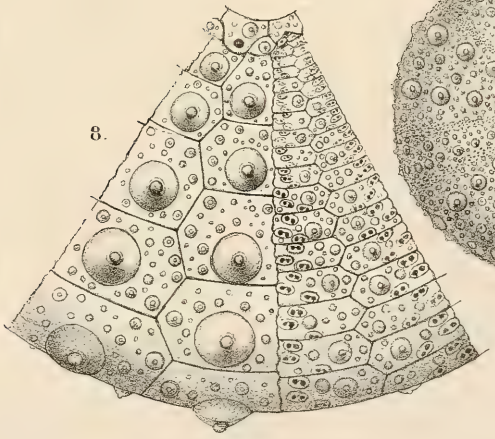
2.

1.

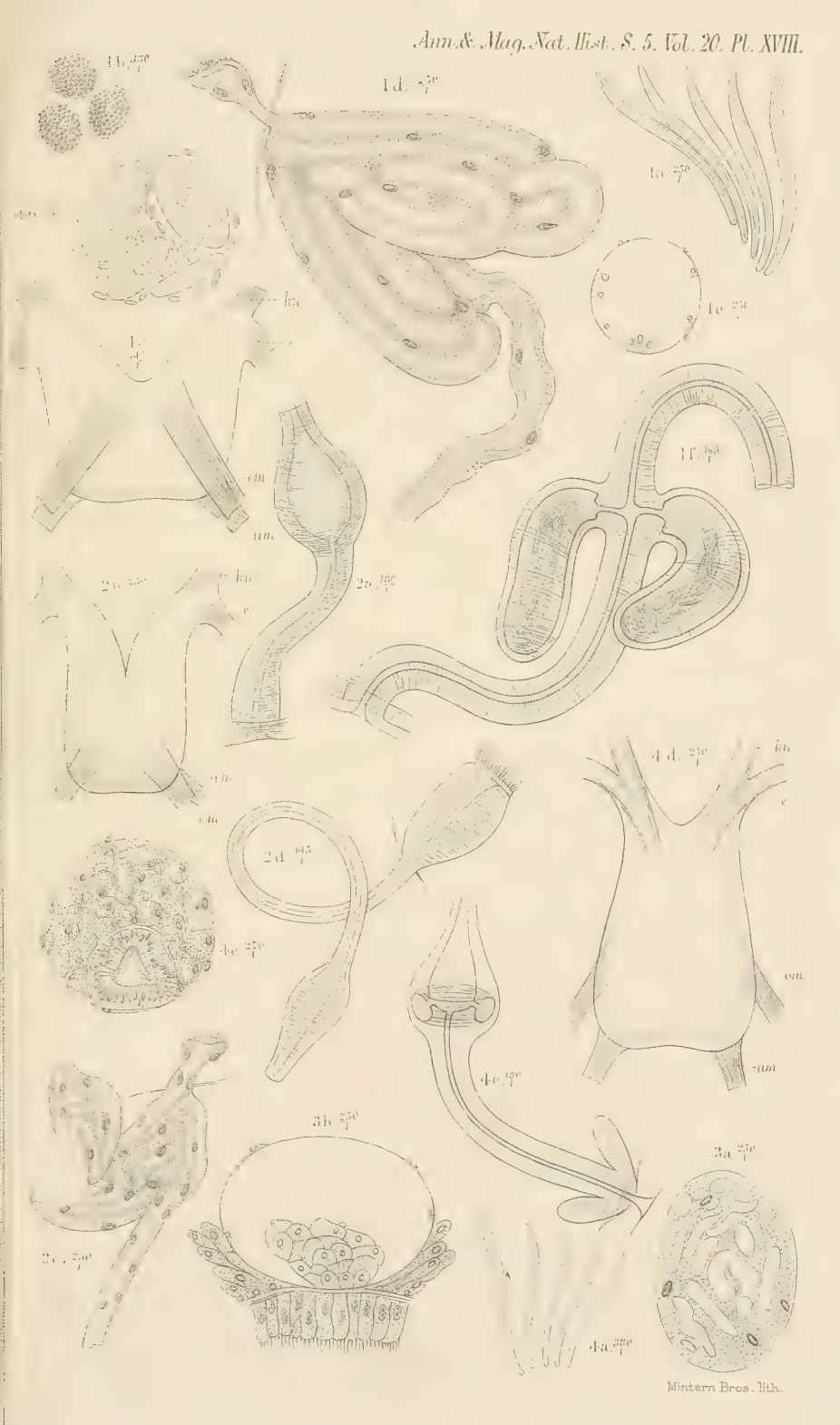


7.

8.



Berjeau & Highley del. et lith. Mintern Bros. imp.



Mintern Bros. lith.

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